Algebra and graphs – 2022 O Level Math D 4024

1. Nov/2022/Paper_4024/11/No.8

Factorise $3a^2 + 12a$.

..... [2]

2. Nov/2022/Paper_4024/11/No.12

Expand and simplify.

(a) $3(2x+1)-2(4x+3)$

..... [2]

(b) $(x+5)(x-3)$

..... [2]

3. Nov/2022/Paper_4024/11/No.13

(a) The nth term of a sequence is $3n^2 - 1$.

Find the first three terms of the sequence.

..... , ... , ... [2]

(b) These are the first five terms of a different sequence.

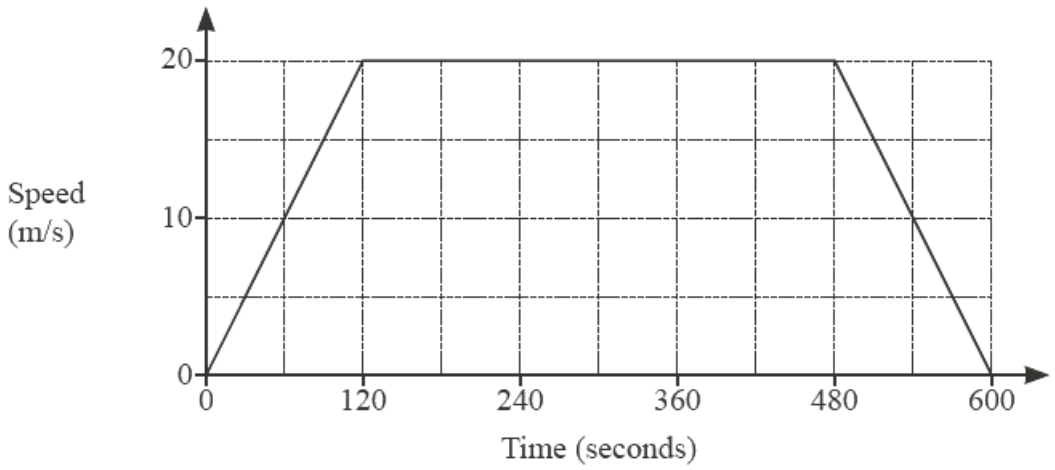
1 3 9 27 81

Find an expression, in terms of n, for the nth term of this sequence.

..... [2]

4. Nov/2022/Paper_4024/11/No.17

The diagram shows the speed–time graph of Sam's journey from home to work.



(a) Calculate the acceleration, in m/s^2, for the first 2 minutes of Sam's journey.

..... m/s^2 [1]

(b) Calculate Sam's average speed, in m/s, for the whole journey.

..... m/s [3]

5. Nov/2022/Paper_4024/11/No.22

(a) $x^2 - 6x - 7 = (x + a)^2 + b$

Find the value of a and the value of b.

$a =$ .....

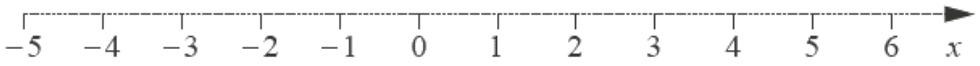
$b =$ ..... [2]

(b) Hence solve the equation $x^2 - 6x - 7 = 0$.
Show your working.

$x =$ ..... or $x =$ ..... [2]

6. Nov/2022/Paper_4024/12/No.12

(a) Represent the inequality $-4 \leqslant x < 2$ on the number line below.



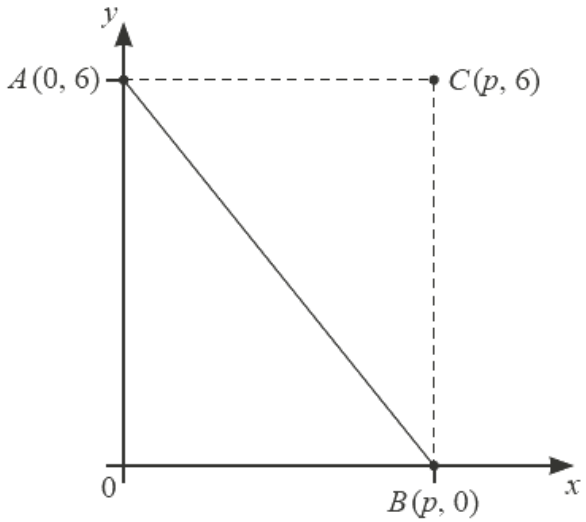
[1]

(b) Solve the inequality.

$$10 - n < 2n - 5$$

..... [2]

7. Nov/2022/Paper_4024/12/No.15



NOT TO SCALE

The diagram shows the points $A(0, 6)$, $B(p, 0)$ and $C(p, 6)$.
The equation of the line AB is $3y + 4x = 18$.

(a) Find the value of p.

$p =$ ..... [1]

(b) Write down the three inequalities that define the region **inside** triangle ABC.

.....

.....

..... [2]

8. Nov/2022/Paper_4024/12/No.17

(a) Simplify.

$(x^2)^3$

..... [1]

(b) $t^{-2} = 9$

Find the value of t.

$t =$ ..... [1]

(c) $\sqrt{5} \times 5^0 = 5^k$

Find the value of k.

$k =$ ..... [1]

9. Nov/2022/Paper_4024/12/No.19

Solve.

$$\frac{3x-1}{6}+\frac{x+2}{4}=\frac{5}{3}$$

$x =$ ..... [4]

10. Nov/2022/Paper_4024/12/No.21

$$f(x) = 1 + \frac{3x}{2} \qquad g(x) = \frac{2}{1-x}$$

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

$f^{-1}(x) =$ ..... [3]

(b) Solve $g(x) = f(-4)$.

$x =$ ..... [3]

11. Nov/2022/Paper_4024/12/No.22

Factorise.

(a) $9p^2 - q^2$

..... [1]

(b) $ac - 3bc + a - 3b$

..... [2]

12. Nov/2022/Paper_4024/12/No.25

Simplify $\dfrac{x^2 - 4x}{x^2 - x - 12}$.

..... [3]

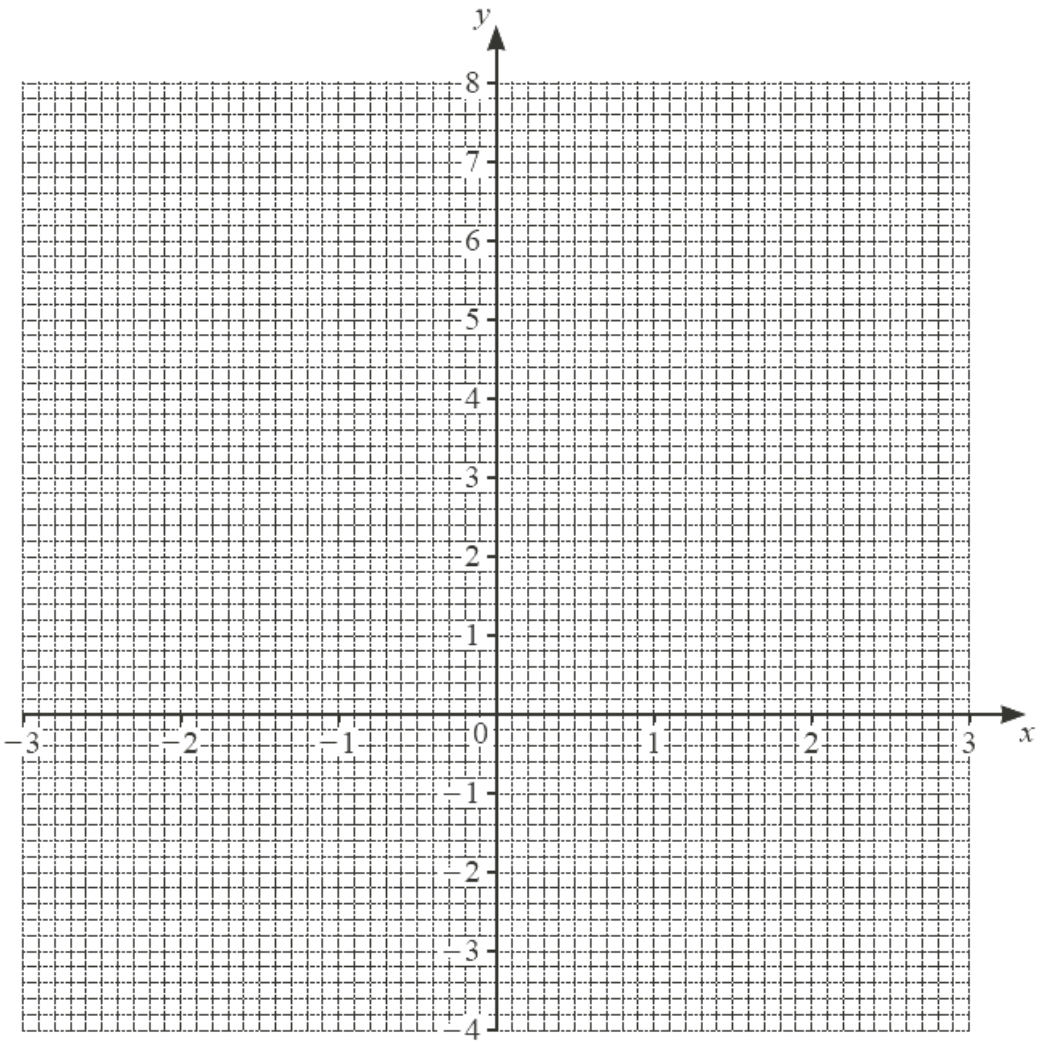
13. Nov/2022/Paper_4024/21/No.3

(a) Complete the table for $y = \frac{x^3}{2} - 3x + 2$.

x	–3	–2	–1	0	1	2	3
y	–2.5	4	4.5	2	–0.5	0	

[1]

(b) On the grid, draw the graph of $y = \frac{x^3}{2} - 3x + 2$ for $-3 \leqslant x \leqslant 3$.



[3]

(c) Write down the coordinates of the minimum point of your graph for $x > 0$.

(..... , ...) [2]

(d) Use your graph to solve the equation $\frac{x^3}{2} - 3x + 2 = 0$.

$x =$ ..... , $x =$ ..... , $x =$ ..... [2]

14. Nov/2022/Paper_4024/21/No.4

$f(x) = x^2 - 7$ $\quad$ $g(x) = \dfrac{4-3x}{2}$

(a) Find $f(8)$.

..... [1]

(b) Find $g(-2)$.

..... [1]

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

$g^{-1}(x) =$ ..... [3]

(d) Solve $f(2x-1)+3=0$.

$x =$ ..... or $x =$ ..... [4]

15. Nov/2022/Paper_4024/21/No.8

Lara and Marco each cycle 50 km on a cycle trail.
Lara cycles at an average speed of x km/h.
Marco cycles at an average speed of $(x-3)$ km/h.

(a) Write down an expression for the time, in hours, Lara takes to complete the trail.

..... hours [1]

(b) Marco takes 15 minutes longer than Lara to complete the trail.

Hence form an equation and show that it simplifies to $x^2-3x-600=0$.

[4]

(c) Solve the equation $x^2-3x-600=0$.
Show your working and give your answers correct to 2 decimal places.

$x =$ ..... or $x =$ ..... [3]

(d) Find the time Marco takes to complete the trail.
Give your answer in hours and minutes, correct to the nearest minute.

..... hours ..... minutes [2]

16. Nov/2022/Paper_4024/21/No.9

(a) Kate thinks of a number, n.
She subtracts 8 from the number and multiplies the result by 3.
The answer is 11 less than the number she thought of.

Form an equation in n and solve it to find Kate's number.

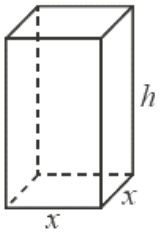
$n =$ ..... [4]

(b) Write as a single fraction in its simplest form.

$$\frac{x^2-4}{2} \div \frac{x^2+2x}{4}$$

..... [3]

17. Nov/2022/Paper_4024/22/No.3



A cuboid has height h cm and a square base of edge x cm.
The volume of the cuboid is 60 cm^3.

(a) Show that the surface area, A cm^2, of the cuboid is given by $A = 2x^2 + \frac{240}{x}$.

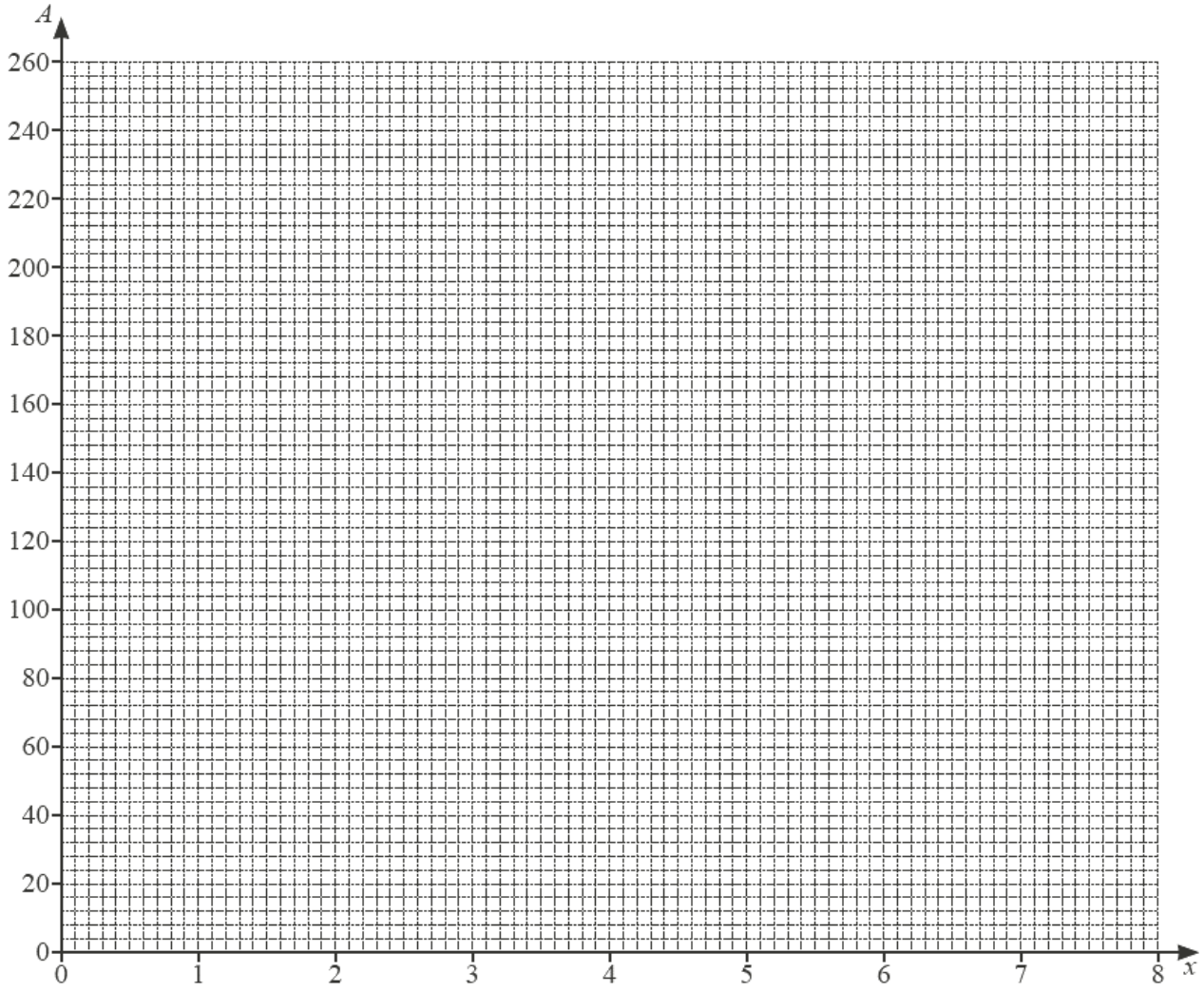
[2]

(b) Complete the table for $A = 2x^2 + \frac{240}{x}$.

x	1	2	3	4	5	6	7	8
A	242	128	98	92			132	158

[2]

(c) On the grid, draw the graph of $A = 2x^2 + \frac{240}{x}$ for $1 \leqslant x \leqslant 8$.



[3]

(d) Find the minimum possible surface area of the cuboid.

..... cm^2 [1]

(e) The cuboid has a surface area of $120\,cm^2$.
The height of the cuboid is greater than the length of the edge of its base.

Find the dimensions of the cuboid.

..... cm by ..... cm by ..... cm [3]

18. Nov/2022/Paper_4024/22/No.5

(a) A bag contains x five-cent coins and y ten-cent coins.

(i) There is a total of 130 coins in the bag.

Write down an equation, in terms of x and y, for the total number of coins in the bag.

..... [1]

(ii) The total value of the coins in the bag is \$8.15 .

Write down an equation, in terms of x and y, for the total value of the coins in the bag.

..... [1]

(iii) Solve the two simultaneous equations to find the number of each type of coin in the bag.
Show your working.

Five-cent coins = ...

Ten-cent coins = ... [3]

(b) A machine makes five-cent coins.
It makes 720 coins per minute.
The machine operates for 24 hours per day.

Calculate the total value, in dollars, of the coins made by the machine in 300 days.
Give your answer in standard form, correct to 3 significant figures.

$ ..... [3]

(c) The diameter of a five-cent coin is 21.2 mm, correct to the nearest 0.1 mm.
The diameter of a ten-cent coin is 17.9 mm, correct to the nearest 0.1 mm.
Marlon makes a line of 10 five-cent coins and a line of 10 ten-cent coins.

Calculate the upper bound of the difference between the lengths of the two lines.

..... mm [3]

19. Nov/2022/Paper_4024/22/No.8

(a) Simplify.

$6v+3w-5w-v$

..... [2]

(b) Solve.

$5x-7=10$

$x =$ ..... [2]

(c) Simplify.

(i) $a \times a \times a^2$

..... [1]

(ii) $b^3 \div b^5$

..... [1]

(d) $r = 4p - 3t$

(i) Find the value of r when $p = 7$ and $t = -5$.

$r =$ ..... [1]

(ii) Rearrange the formula to make p the subject.

$p =$ ..... [2]

(e) Solve.

$5x^2 + 3x - 6 = 0$

Show all your working and give your answers correct to 3 significant figures.

$x =$ ..... or $x =$ ..... [3]

20. June/2022/Paper_4024/11/No.13

(a) Expand and simplify.

(i) $(x+3)(x-4)$

..... [2]

(ii) $5(x+2)-2(2x-1)$

..... [2]

(b) Write as a single fraction in its simplest form.

$$\frac{4b}{3}+\frac{5b}{9}$$

..... [2]

21. June/2022/Paper_4024/11/No.15

(a) Evaluate $7^{-3} \div 7^{-4}$.

..... [1]

(b) Find the value of k when $(3^6)^k = 3^2$.

$k =$ ..... [1]

(c) Simplify $3(2^2 \times 3^3 \times 5^4)^2$.
Give your answer in the form $2^a \times 3^b \times 5^c$.

..... [2]

22. June/2022/Paper_4024/11/No.20

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

(a) Find $f(3)$.

..... [1]

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

$f^{-1}(x) =$ ..... [3]

23. June/2022/Paper_4024/11/No.22

Factorise.

(a) $5ax-3ay-10cx+6cy$

..... [2]

(b) $15x^2-7x-4$

..... [2]

24. June/2022/Paper_4024/11/No.23

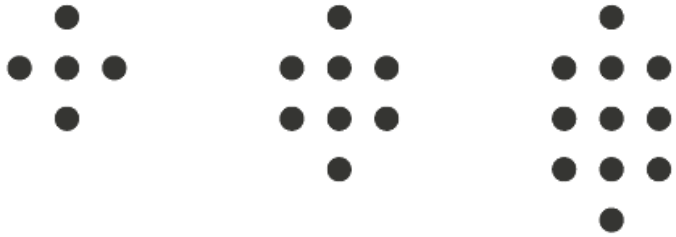
$$y = \frac{3x+2}{2x-1}$$

Rearrange the formula to make x the subject.

$x =$ ..... [4]

25. June/2022/Paper_4024/12/No.9

Shani makes a sequence of patterns using counters.



Pattern 1 Pattern 2 Pattern 3

(a) Complete the table.

Pattern number	1	2	3	4	5
Number of counters	5	8	11		

[1]

(b) Find an expression, in terms of n, for the number of counters in Pattern n.

..... [2]

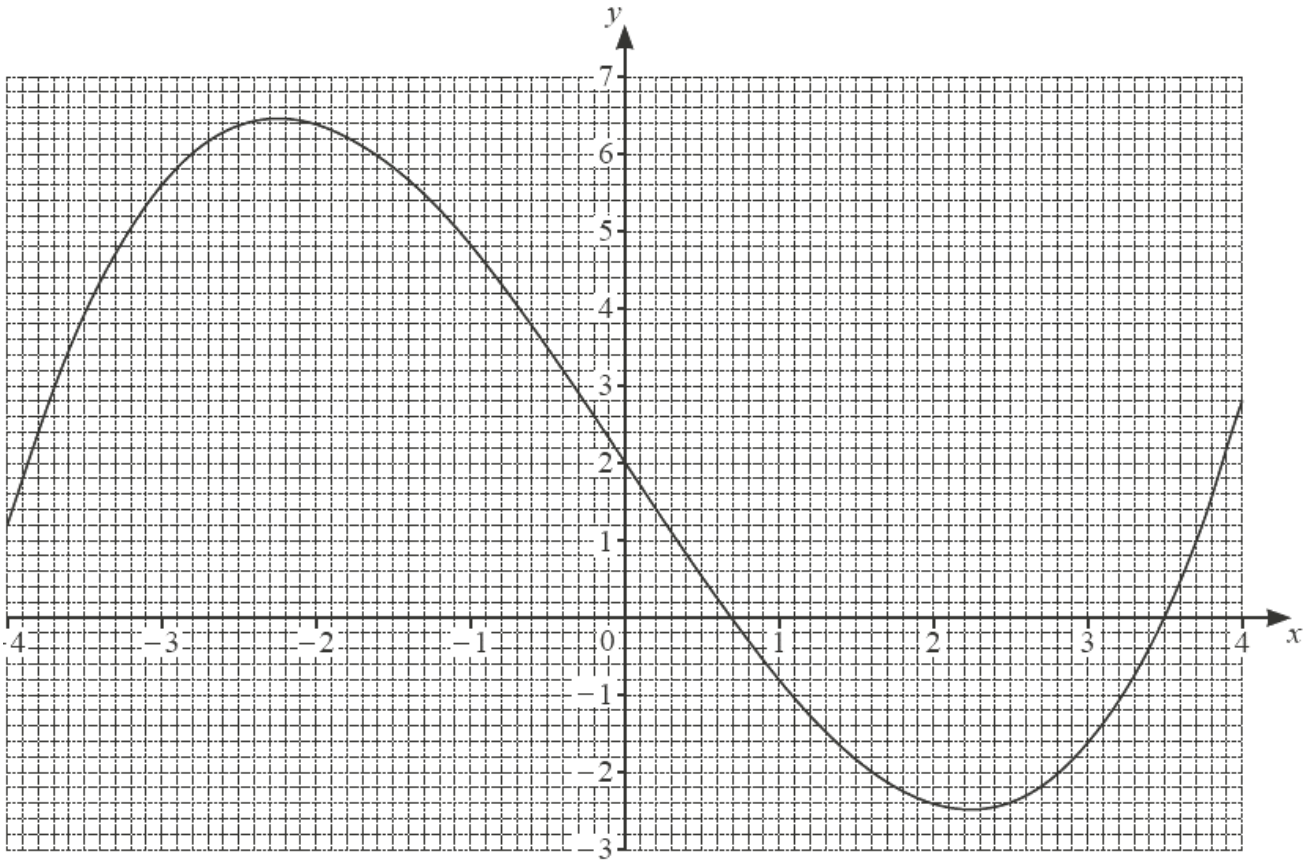
(c) Shani has 100 counters.
She uses some of the counters to make Pattern 20.
She uses all the remaining counters to make Pattern k.

Find the value of k.

$k =$ ..... [3]

26. June/2022/Paper_4024/12/No.16

The graph of $y = \frac{x^3}{5} - 3x + 2$ is drawn on the grid.



(a) By drawing a tangent, estimate the gradient of the curve at $x = -1$.

..... [2]

(b) By drawing a suitable straight line on the graph, find the solutions of the equation $\frac{x^3}{5} - 3x = 0$.

..... [3]

27. June/2022/Paper_4024/12/No.18

$f(x) = 3x - 7$

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

$f^{-1}(x) =$ ..... [2]

28. June/2022/Paper_4024/12/No.21

(a) Factorise $4x^2 + 5x - 6$.

..... [2]

(b) Simplify $\left(\frac{16}{x^6}\right)^{-\frac{1}{2}}$.

..... [2]

29. June/2022/Paper_4024/12/No.24

(a) Factorise $4x^2 + 5x - 6$.

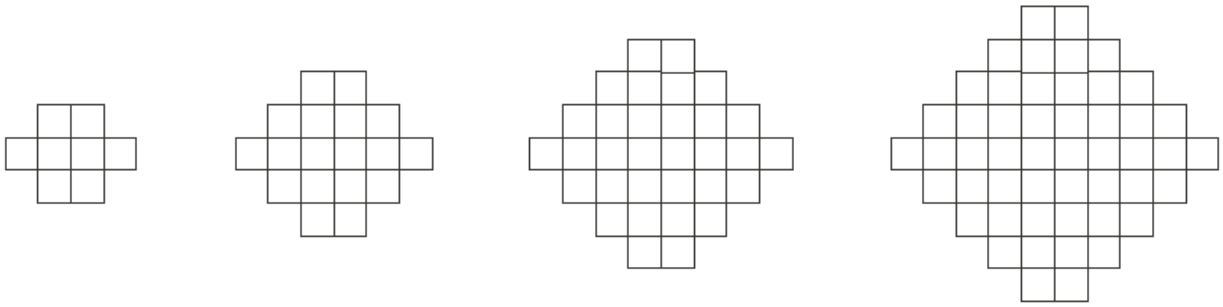
..... [2]

(b) Simplify $\left(\frac{16}{x^6}\right)^{-\frac{1}{2}}$.

..... [2]

30. June/2022/Paper_4024/21/No.2

Here are the first four patterns in a sequence made using grey tiles and white tiles.



Pattern 1 Pattern 2 Pattern 3 Pattern 4

(a) Complete the table for the first five patterns in this sequence.

Pattern number	1	2	3	4	5
Number of grey tiles	6	10	14		
Number of white tiles	2	8	18		
Total number of tiles	8	18	32		

[2]

(b) Find an expression, in terms of n, for the number of grey tiles in Pattern n.

..... [2]

(c) Pattern k has 98 grey tiles.

Find k.

$k =$ ..... [2]

(d) Find an expression, in terms of n, for the number of white tiles in Pattern n.

..... [2]

(e) Find the **total** number of tiles in Pattern 20.

..... [2]

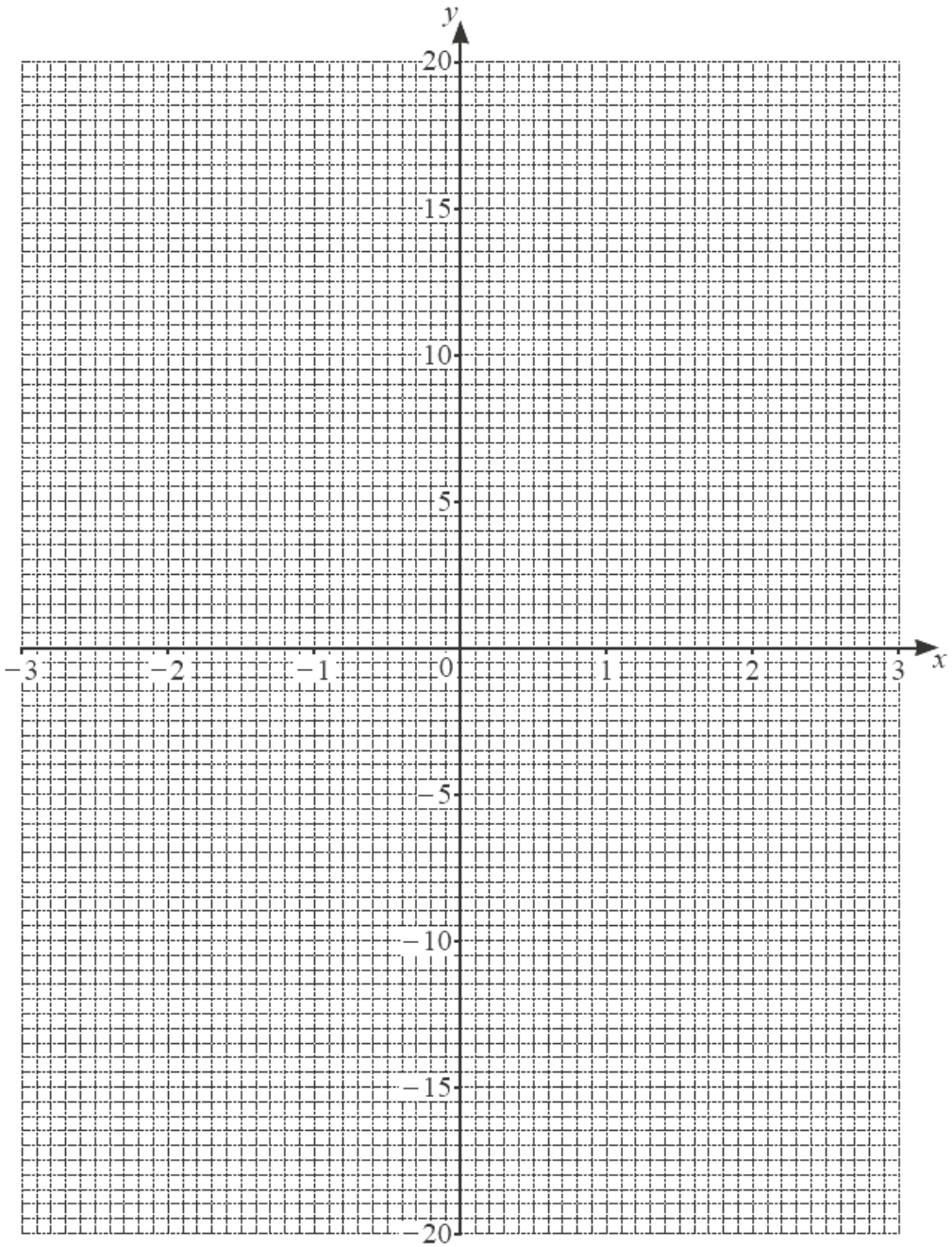
31. June/2022/Paper_4024/21/No.5

(a) Complete the table of values for $y = x^3 - 4x + 3$.

x	-3	-2	-1	0	1	2	3
y		3	6	3	0	3	18

[1]

(b) Draw the graph of $y = x^3 - 4x + 3$ for $-3 \leqslant x \leqslant 3$.



[3]

(c) By drawing a suitable straight line on your graph, find the solutions of the equation $x^3 - 4x - 2 = 0$.

$x =$ ..... or $x =$ ..... or $x =$ ..... [3]

32. June/2022/Paper_4024/21/No.8

(a) Apples cost $\$x$ per kilogram and oranges cost $\$y$ per kilogram.
The total cost of 5 kg of apples and 10 kg of oranges is \$40.

(i) Show that $x + 2y = 8$.

[1]

(ii) The total cost of 4 kg of apples and 3 kg of oranges is \$19.

Use simultaneous equations to find the cost of 1 kilogram of apples and of 1 kilogram of oranges.
Show your working.

Apples \$.....

Oranges \$..... [4]

(b) Solve $-8 < 4(x-3) < 7$.

..... [3]

(c) Solve $\frac{4}{x-1}+\frac{2}{2x+3}=1$.

Show all your working and give your answers correct to 2 decimal places.

$x =$ ..... or $x =$ ..... [6]

33. June/2022/Paper_4024/22/No.2

(a) $A = 3p + q$

Find q when $A = 23$ and $p = 5$.

$q =$ ..... [2]

(b) Expand and simplify $2(2x+5)+3(x-6)$.

..... [2]

(c) Solve $5y+3=1$.

$y =$ ..... [2]

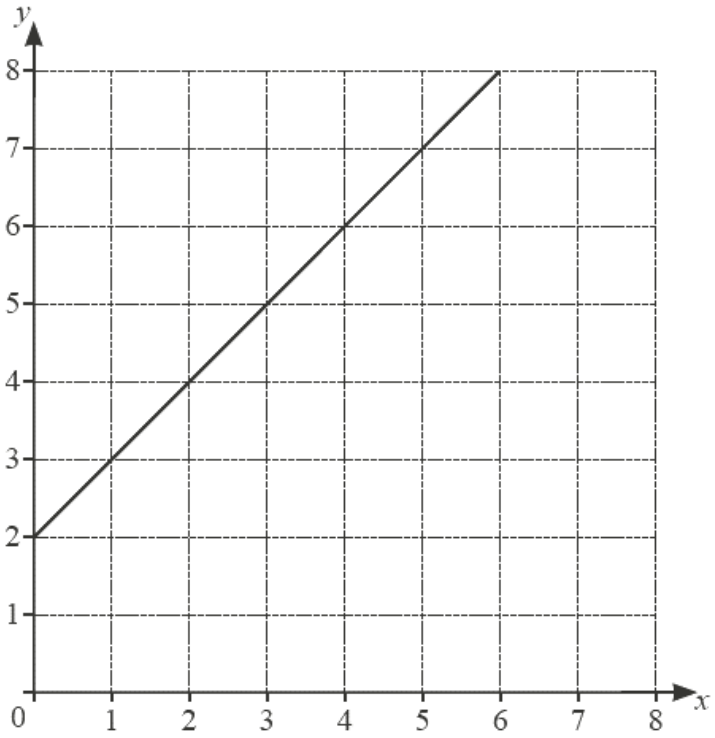
(d) Factorise $12r^2 - 8rs$.

..... [2]

(e) Rearrange $a = 3b$ to make b the subject.

..... [1]

34. June/2022/Paper_4024/22/No.6



The line $y = x + 2$ is drawn on the grid.

(a) On the grid, draw the line $x + 2y = 7$. [2]

(b) Use your graph to find the solution of these simultaneous equations.

$$y = x + 2$$
$$x + 2y = 7$$

$x =$ .....

$y =$ ..... [1]

(c) The region R is defined by these three inequalities.

$$y \leqslant x+2 \qquad x+2y \geqslant 7 \qquad x \leqslant 5$$

(i) Shade and label region R. [2]

(ii) The point Z is in region R.
The x-coordinate and the y-coordinate of point Z are both integers.
Point Z does **not** lie on the boundary of region R.

(a) Find the number of possible positions of point Z.

..... [1]

(b) The y-coordinate of point Z is one more than its x-coordinate.

Write down all the possible coordinates for point Z.

..... [2]