**Elite Mathematics**
Pearson Edexcel International GCSE

IGCSE LINEAR · 4MA1

# Linear Expertise Questions

273 harder end-of-paper questions (Q20+), grouped by topic.

| 273 | 2020–2026 | Questions |
|---|---|---|
| topic placements | 55 past papers | checked by Dr Eslam |



**Dr Eslam Ahmed**
Assistant Lecturer, Faculty of Engineering, Cairo University
**eliteigcse.com · free for every student**

TOPIC

# Rounding, Estimation & Bounds

Every past-paper question on this topic, 2020 to 2026.

# Question 20

3 marks | Rounding, Estimation & Bounds

**20** $P = \dfrac{t - w}{y}$

$t$ = 9.7 correct to 1 decimal place

$w$ = 5.9 correct to 1 decimal place

$y$ = 3 correct to 1 significant figure

Calculate the upper bound for the value of $P$.
Show your working clearly.

**(Total for Question 20 is 3 marks)**

# Question 22

4 marks | Rounding, Estimation & Bounds

**22** The diagram shows triangle $ABC$

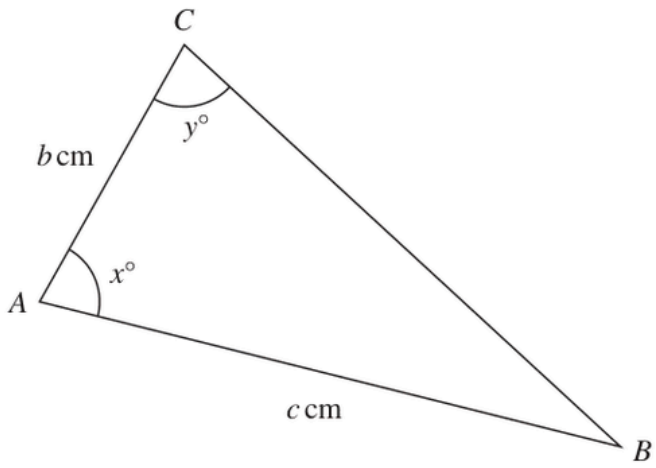



Diagram **NOT** accurately drawn

$c = 11.5$ correct to one decimal place
$x = 80$ correct to the nearest whole number
$y = 75$ correct to the nearest whole number

Calculate the upper bound for the value of $b$
Show your working clearly.
Give your answer correct to 3 significant figures.

**(Total for Question 22 is 4 marks)**

# Question 25

4 marks | Rounding, Estimation & Bounds

**25** A solid sphere has a radius of 2.8 centimetres, correct to 1 decimal place.
The sphere has a mass of $M\pi$ grams, where $M = 260$ correct to 2 significant figures.

Work out the upper bound for the density of the sphere.
Give your answer in $g/cm^3$ correct to 2 decimal places.
Show your working clearly.

..... $g/cm^3$

**(Total for Question 25 is 4 marks)**

# Question 21

3 marks | Rounding, Estimation & Bounds

**21** $T = \dfrac{x^2 + y^2}{w}$

$x = 28.4$ correct to 1 decimal place.

$y = 17$ correct to 2 significant figures.

$w = 90$ correct to the nearest 5

Calculate the upper bound for the value of $T$

Give your answer correct to 3 significant figures.
Show your working clearly.

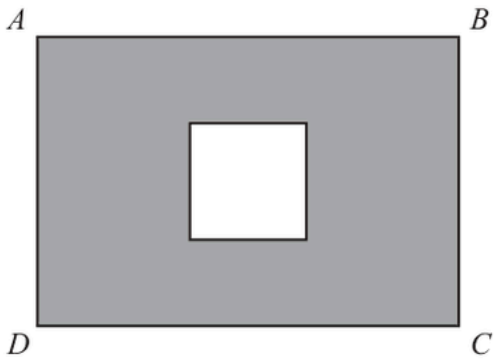
**(Total for Question 21 is 3 marks)**

# Question 22

4 marks | Rounding, Estimation & Bounds

**22** The diagram shows a square inside rectangle $ABCD$

Diagram **NOT** accurately drawn




The total area of the region shown shaded in the diagram is $X\text{cm}^2$

$AB = 11.5\text{ cm}$ correct to the nearest 0.5 cm
$BC = 9.2\text{ cm}$ correct to 2 significant figures
side of square $= 4.1\text{ cm}$ correct to 2 significant figures

By considering bounds, work out the value of $X$ to a suitable degree of accuracy.
Show your working clearly.

$X =$ .....

**(Total for Question 22 is 4 marks)**

4MA1/2H NOVEMBER 2025

# Question 24

5 marks | Rounding, Estimation & Bounds

**24** $D = \dfrac{n}{p - q}$

$n = 10.3$ correct to 1 decimal place
$p = 7.24$ correct to 2 decimal places
$q = 4.39$ correct to 2 decimal places

By considering bounds, work out the value of $D$ to a suitable degree of accuracy.
Show your working clearly.

**(Total for Question 24 is 5 marks)**



TOPIC

# Surds

Every past-paper question on this topic, 2020 to 2026.

# Question 20

3 marks | Surds

**20** The area of a rectangle is $18\,\text{cm}^2$

The length of the rectangle is $\left(\sqrt{7}+1\right)$ cm.

Without using a calculator and showing each stage of your working,

find the width of the rectangle.
Give your answer in the form $a\sqrt{b}+c$ where $a$, $b$ and $c$ are integers.

..... cm

**(Total for Question 20 is 3 marks)**

4MA1/1HR JUNE 2022

# Question 21

4 marks | Surds

**21** Express $\dfrac{3+\sqrt{8}}{\left(\sqrt{2}-1\right)^2}$ in the form $p+\sqrt{q}$ where $p$ and $q$ are integers.

Show each stage of your working clearly.

**(Total for Question 21 is 4 marks)**

# Question 23

4 marks | Surds

**23** The diagram shows a cuboid with a square cross section.

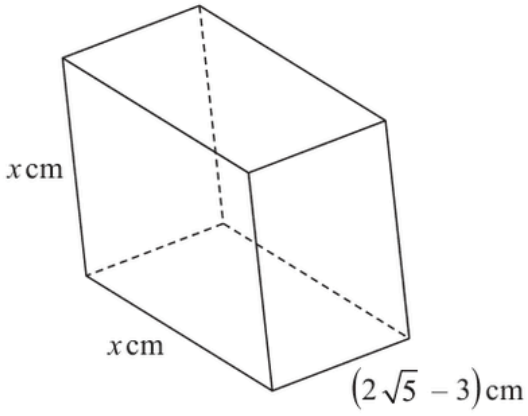



Diagram **NOT** accurately drawn

The volume of the cuboid is $(13 + 6\sqrt{5})\text{cm}^3$

Without using a calculator, find the value of $x$
Give your answer in the form $a + \sqrt{b}$ where $a$ and $b$ are integers.
Show your working clearly.

$x =$ .....

**(Total for Question 23 is 4 marks)**

TOPIC

# Standard & Compound Units

Every past-paper question on this topic, 2020 to 2026.

# Question 21

6 marks | Standard & Compound Units

**21** The diagram shows a solid made from a cylinder and a hemisphere.
The cylinder and the hemisphere are both made from the same metal.

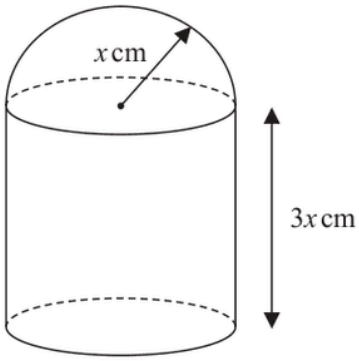



Diagram **NOT** accurately drawn

The plane face of the hemisphere coincides with the upper plane face of the cylinder.

The radius of the cylinder and the radius of the hemisphere are both $x$ cm.
The height of the cylinder is $3x$ cm.

The total surface area of the solid is $81\pi$ cm$^2$
The mass of the solid is 840 grams.

The following table gives the density of each of four metals.

| Metal | Density (g/cm$^3$) |
|---|---|
| Aluminium | 2.7 |
| Nickel | 8.9 |
| Gold | 19.3 |
| Silver | 10.5 |

The metal used to make the solid is one of the metals in the table.

Determine the metal used to make the solid.
Show your working clearly.

**(Total for Question 21 is 6 marks)**

# Question 26

6 marks | Standard & Compound Units

**26** A solid cone is joined to a solid hemisphere to make the solid shown below.

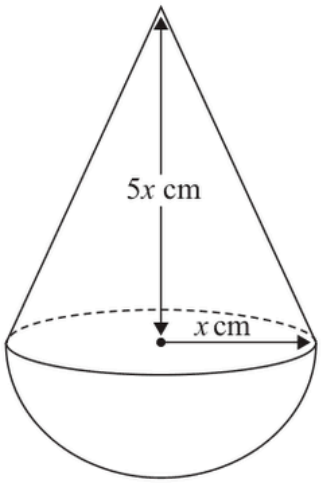



Diagram **NOT** accurately drawn

The cone is made from copper.
The density of copper is $9\,g/cm^3$

The hemisphere is made from a different metal.

The total mass of the solid is $4752\pi$ grams
The total volume of the solid is $504\pi\,cm^3$

Work out the density of the hemisphere.
Show your working clearly.

..... $g/cm^3$

**(Total for Question 26 is 6 marks)**

TOPIC

# Algebraic Fractions

Every past-paper question on this topic, 2020 to 2026.

# Question 21

3 marks | Algebraic Fractions

**21** Express $\left(\frac{20}{x^2 - 36} - \frac{2}{x - 6}\right) \times \frac{1}{4 - x}$ as a single fraction in its simplest form.

Show clear algebraic working.

.....

# Question 21

3 marks | Algebraic Fractions

**21** $a = \dfrac{14}{3x - 7}$ $\quad x = \dfrac{7}{4y - 3}$

Express $a$ in the form $\dfrac{py + q}{ry + s}$ where $p$, $q$, $r$ and $s$ are integers.

Give your answer in its simplest form.

$a =$ .....

**(Total for Question 21 is 3 marks)**

# Question 24

4 marks | Algebraic Fractions

**24** Express

$$\left(\frac{4}{2x-5}-\frac{3}{2x-3}\right)\div\frac{9x-4x^3}{6x^2-17x+5}$$

as a single fraction in its simplest form.

**(Total for Question 24 is 4 marks)**

# Question 21

5 marks | Algebraic Fractions

**21** Express

$$\frac{1}{3x-2} \times \frac{9x^2-4}{3x^2-13x-10} - \frac{7}{x-1}$$

as a single fraction in its simplest form.

**(Total for Question 21 is 5 marks)**

# Question 21

4 marks | Algebraic Fractions

**21** Write $\dfrac{25x^2 - 64}{5x^2 - 13x - 6} \times \dfrac{x^2 - 8x + 15}{5x + 8} - (x - 7)$

as a single fraction in its simplest form.
Show clear algebraic working.

**(Total for Question 21 is 4 marks)**

# Question 21

4 marks | Algebraic Fractions

**21** Given that $x = \dfrac{5}{9y + 5}$ and that $y = \dfrac{5}{5a - 2}$

find an expression for $x$ in terms of $a$.
Give your expression as a single fraction in its simplest form.

**(Total for Question 21 is 4 marks)**

# Question 23

3 marks | Algebraic Fractions

**23** Express $\left(\frac{20}{x^2 - 36} - \frac{2}{x - 6}\right) \times \frac{1}{4 - x}$ as a single fraction in its simplest form.

**(Total for Question 23 is 3 marks)**

# Question 23

4 marks | Algebraic Fractions

**23** Simplify $\left(x^2 - 4\right) \div \left(\dfrac{4x^2 - 7x - 2}{x}\right) - 2x$

Give your answer in the form $\dfrac{ax^2}{bx + c}$ where $a$, $b$ and $c$ are integers.

**(Total for Question 23 is 4 marks)**

# Question 24

5 marks | Algebraic Fractions

**24** Solve $\dfrac{45x^3 - 80x}{3x^2 + x - 4} \times \left( \dfrac{1}{3x - 4} + \dfrac{1}{x} \right) = \dfrac{4(x + 2)}{5x - 8}$

Show clear algebraic working.

$x =$ .....

**(Total for Question 24 is 5 marks)**

# Question 20

3 marks | Algebraic Fractions

**20** Given that $k = x - y$ and $x = \frac{1}{4y}$

express $\frac{5k}{x+2}$ in the form $\frac{a - by^2}{c + dy}$ where $a$, $b$, $c$ and $d$ are integers.

**(Total for Question 20 is 3 marks)**

4MA1/2HR JUNE 2024

# Question 26

4 marks | Algebraic Fractions

**26** Write $4 - \left[ (3x - 5) \div \dfrac{3x^2 + x - 10}{4x - 1} \right]$ as a single fraction in its simplest form.

**(Total for Question 26 is 4 marks)**

# Question 20

3 marks | Algebraic Fractions

**20** Given that $k = m + n$ and $m = \frac{3}{4n}$

express $\frac{7k}{5 - m}$ in the form $\frac{a + bn^2}{cn - d}$ where $a$, $b$ and $c$ are integers and $d$ is prime.

**(Total for Question 20 is 3 marks)**

# Question 23

4 marks | Algebraic Fractions

**23** $\dfrac{4x^2-4x-120}{5x^2-180} \div \dfrac{x^2+5x}{10x^2+60x} = p$ where $p$ is an integer.

Find the value of $p$

Show clear algebraic working.

$p =$ .....

**(Total for Question 23 is 4 marks)**

# Question 24

4 marks | Algebraic Fractions

**24** Write $(2x-1)+\dfrac{2x^2-5x-12}{x^2-16}\times\dfrac{x^2+4x}{6x^2+11x+3}$ as a single fraction in its simplest form.

Show clear algebraic working.

**(Total for Question 24 is 4 marks)**

# Question 23

3 marks | Algebraic Fractions

**23** $a = \dfrac{2x + 5}{1 - x}$ $x = \dfrac{5 - 2y}{3y}$

Write $a$ in the form $\dfrac{m + ny}{p(y - 1)}$ where $m$, $n$ and $p$ are integers.

Show your working clearly.

$a =$ .....

**(Total for Question 23 is 3 marks)**

# Question 25

3 marks | Algebraic Fractions

**25** $a = \dfrac{2x + 5}{1 - x}$ $x = \dfrac{5 - 2y}{3y}$

Write $a$ in the form $\dfrac{m + ny}{p(y - 1)}$ where $m$, $n$ and $p$ are integers.

Show your working clearly.

$a =$ .....

**(Total for Question 25 is 3 marks)**

# Question 28

4 marks | Algebraic Fractions

**28** Solve $\dfrac{6x^3 + 5x^2 + x}{4x^2 - 1} \div \dfrac{15x^2 - x - 2}{8x - 4} = 2x$

Show clear algebraic working.

$x =$ .....

**(Total for Question 28 is 4 marks)**

# Question 20

4 marks | Algebraic Fractions

**20** Express $\left(\frac{5}{4x-7}-\frac{3}{3x-5}\right)\div\frac{9x^2-16}{6x^2-7x-5}$ as a single fraction in its simplest form.

Show clear algebraic working.

.....

**(Total for Question 20 is 4 marks)**

TOPIC

# Algebraic Roots & Indices

Every past-paper question on this topic, 2020 to 2026.

# Question 22

3 marks | Algebraic Roots & Indices

**22** $\dfrac{16 \times (\sqrt{27})^{}}{6 \times 9^{2n+8}} = 3^x$

Express $x$ in terms of $n$

Show your working clearly and simplify your expression.

$x =$ .....

# Question 21

7 marks | Algebraic Roots & Indices

**21** (a) Simplify fully $\dfrac{10x^2 + 23x + 12}{4x^2 - 9}$

.....

(3)

$2^{2y} \times 2^{3y+2} = \dfrac{8^{5y}}{4^n}$

(b) Find an expression for $n$ in terms of $y$.
Show clear algebraic working and simplify your expression.

.....

(4)

**(Total for Question 21 is 7 marks)**

# Question 21

5 marks | Algebraic Roots & Indices

**21** Given that $M = \dfrac{18^{4n} \times 2^{3(n^2-6n)} \times 3^{2(1-4n)}}{12^2}$

find the values of $n$ for which $M = 2$

**(Total for Question 21 is 5 marks)**

# Question 24

3 marks | Algebraic Roots & Indices

**24**

$$\frac{18 \times (\sqrt{27})}{6 \times 9^{2n+8}} = 3^x$$

Express $x$ in terms of $n$
Show your working clearly and simplify your expression.

$x =$ .....

**(Total for Question 24 is 3 marks)**

# Question 24

5 marks | Algebraic Roots & Indices

**24** Given that

$$2^n = 2^{x^2} \times 16^x \times 8$$

and

$$x > 0$$

find an expression for $x$ in terms of $n$
State any restrictions on $n$

**(Total for Question 24 is 5 marks)**

4MA1/2H JUNE 2024

# Question 23

3 marks | Algebraic Roots & Indices

**23** Simplify $\dfrac{30 \times 25^{2x+7}}{\sqrt{180} \times \left(\sqrt{5}\right)^{4x+9}}$

Give your answer in the form $5^w$ where $w$ is an expression in terms of $x$
Show each stage of your working clearly.

**(Total for Question 23 is 3 marks)**



TOPIC

# Forming & Solving Equations

Every past-paper question on this topic, 2020 to 2026.

# Question 20

3 marks | Forming & Solving Equations

**20** Here is a quadratic equation.

$$ax^2 + 4x + c = 0$$

The solutions of this equation are given by $x = \dfrac{-4 \pm 2\sqrt{39}}{10}$

Find the value of $a$ and the value of $c$
Show your working clearly.

$a =$ .....

$c =$ .....

**(Total for Question 20 is 3 marks)**



TOPIC

# Simultaneous Equations

Every past-paper question on this topic, 2020 to 2026.

# Question 20

5 marks | Simultaneous Equations

**20** Solve the simultaneous equations

$$x - 2y = 3$$
$$x^2 - y^2 + 2x = 10$$

Show clear algebraic working.

**(Total for Question 20 is 5 marks)**

# Question 21

5 marks | Simultaneous Equations

**21** Solve the simultaneous equations

$$x - 2y = 3$$
$$x^2 - y^2 + 2x = 10$$

Show clear algebraic working.

**(Total for Question 21 is 5 marks)**

4MA1/2H JUNE 2023

# Question 21

5 marks | Simultaneous Equations

**21** Solve the simultaneous equations

$$2x^2 + 3y^2 = 11$$
$$x = 3y - 1$$

Show clear algebraic working.

**(Total for Question 21 is 5 marks)**

# Question 22

5 marks | Simultaneous Equations

**22** Solve the simultaneous equations

$$x^2 + y^2 = y + 11$$
$$y = 3x - 1$$

Show clear algebraic working.

**(Total for Question 22 is 5 marks)**

# Question 22

5 marks | Simultaneous Equations

**22** Solve the simultaneous equations

$$x^2 + y^2 + y = 3$$

$$x + 2 = y$$

Show clear algebraic working.

**(Total for Question 22 is 5 marks)**

4MA1/1H JUNE 2025

# Question 22

5 marks | Simultaneous Equations

**22** Solve the simultaneous equations

$$x^2 + 3y + y^2 = 7$$
$$y = x + 2$$

Show clear algebraic working.

**(Total for Question 22 is 5 marks)**

# Question 22

5 marks | Simultaneous Equations

**22** Solve the simultaneous equations

$$x^2 + y^2 = 41$$
$$2x + y = 3$$

Show clear algebraic working.

**(Total for Question 22 is 5 marks)**

# Question 22

5 marks | Simultaneous Equations

**22** Solve the simultaneous equations

$$y^2 + 5y + x^2 = 12$$

$$x = y + 5$$

Show clear algebraic working.

**(Total for Question 22 is 5 marks)**

# Question 20

5 marks | Simultaneous Equations

**20** Solve the simultaneous equations

$$x^2 + y^2 = 3xy - 11$$
$$y = x + 2$$

Show clear algebraic working.

**(Total for Question 20 is 5 marks)**

# Question 21

5 marks | Simultaneous Equations

**21** Solve the simultaneous equations

$$y^2 = x^2 + 7$$
$$y = 3x - 5$$

Show clear algebraic working.

**(Total for Question 21 is 5 marks)**

TOPIC

# Inequalities (Solving & Graphing)

Every past-paper question on this topic, 2020 to 2026.

# Question 22

5 marks | Inequalities (Solving & Graphing)

**22** Here is a rectangle.

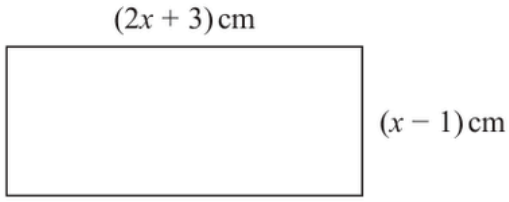



Diagram **NOT** accurately drawn

Given that the area of the rectangle is less than $75\,\text{cm}^2$

find the range of possible values of $x$

**(Total for Question 22 is 5 marks)**

# Question 20

4 marks | Inequalities (Solving & Graphing)

**20** Solve $6x^2 - 7x - 20 > 0$
Show clear algebraic working.

**(Total for Question 20 is 4 marks)**

# Question 20

3 marks | Inequalities (Solving & Graphing)

**20** Solve the inequality $10x^2 + 11x - 21 < 0$
Show clear algebraic working.

**(Total for Question 20 is 3 marks)**

# Question 20

3 marks | Inequalities (Solving & Graphing)

**20** Solve the inequality $2x^2 - 7x - 15 > 0$

Show clear algebraic working.

**(Total for Question 20 is 3 marks)**

# Question 21

3 marks | Inequalities (Solving & Graphing)

**21** Solve the inequality $2x^2 - 7x - 15 > 0$

Show clear algebraic working.

**(Total for Question 21 is 3 marks)**

4MA1/1H NOVEMBER 2025

# Question 25

3 marks | Inequalities (Solving & Graphing)

**25** Solve the inequality $2x^2 + x - 28 > 0$
Show clear algebraic working.

**(Total for Question 25 is 3 marks)**

Dr Eslam Ahmed · eliteigcse.com

TOPIC

# Completing the Square

Every past-paper question on this topic, 2020 to 2026.

# Question 20

4 marks | Completing the Square

**20** Find the values of $a$, $b$ and $c$ so that

$$7 + 12x - 2x^2$$

is written as $a - b(x - c)^2$

$a =$ .....

$b =$ .....

$c =$ .....

**(Total for Question 20 is 4 marks)**

# Question 23

3 marks | Completing the Square

**23** Express $7 - 12x - 2x^2$ in the form $a + b(x + c)^2$ where $a$, $b$ and $c$ are integers.

**(Total for Question 23 is 3 marks)**

# Question 22

4 marks | Completing the Square

**22** The curve **S** has equation $y = f(x)$ where $f(x) = x^2$
The curve **T** has equation $y = g(x)$ where $g(x) = 2x^2 - 12x + 13$

By writing $g(x)$ in the form $a(x - b)^2 - c$, where $a$, $b$ and $c$ are constants,
describe fully a series of transformations that map the curve **S** onto the curve **T**.

**(Total for Question 22 is 4 marks)**

4MA1/1H JANUARY 2022

# Question 20

4 marks | Completing the Square

**20** (a) Express $7 + 12x - 3x^2$ in the form $a + b(x + c)^2$ where $a$, $b$ and $c$ are integers.

.....

**(3)**

**C** is the curve with equation $y = 7 + 12x - 3x^2$
The point $A$ is the maximum point on **C**

(b) Use your answer to part (a) to write down the coordinates of $A$

(..... , .....)

**(1)**

**(Total for Question 20 is 4 marks)**

4MA1/1HR JUNE 2022

# Question 23

5 marks | Completing the Square

**23** (a) Express $2x^2 - 12x + 3$ in the form $a(x + b)^2 + c$ where $a$, $b$ and $c$ are integers.

.....

**(3)**

The curve **C** has equation $y = 2(x + 4)^2 - 12(x + 4) + 3$

The point $M$ is the minimum point on **C**

(b) Find the coordinates of $M$

(..... , .....)

**(2)**

**(Total for Question 23 is 5 marks)**

# Question 24

4 marks | Completing the Square

**24** Express each of $a$, $b$ and $c$ in terms of $q$ so that

$$q + 12x - qx^2$$

can be written as $a - b(x - c)^2$

$a =$ .....

$b =$ .....

$c =$ .....

**(Total for Question 24 is 4 marks)**

# Question 20

5 marks | Completing the Square

**20** (a) Express $2x^2 - 11x + 9$ in the form $a(x - b)^2 - c$ where $a$, $b$ and $c$ are numbers to be found.

.....

**(3)**

The curve **C** has equation $y = 2(x - 3)^2 - 11(x - 3) + 9$

The point $P$ is the minimum point on **C**

(b) Find the coordinates of $P$

(..... , .....)

**(2)**

**(Total for Question 20 is 5 marks)**

# Question 25

4 marks | Completing the Square

**25** $f(x) = 17 - 3x^2 + 12x$

Write $f(x)$ in the form $a - b(x - c)^2$ where $a$, $b$ and $c$ are constants.

$f(x) =$ .....

**(Total for Question 25 is 4 marks)**

# Question 25

6 marks | Completing the Square

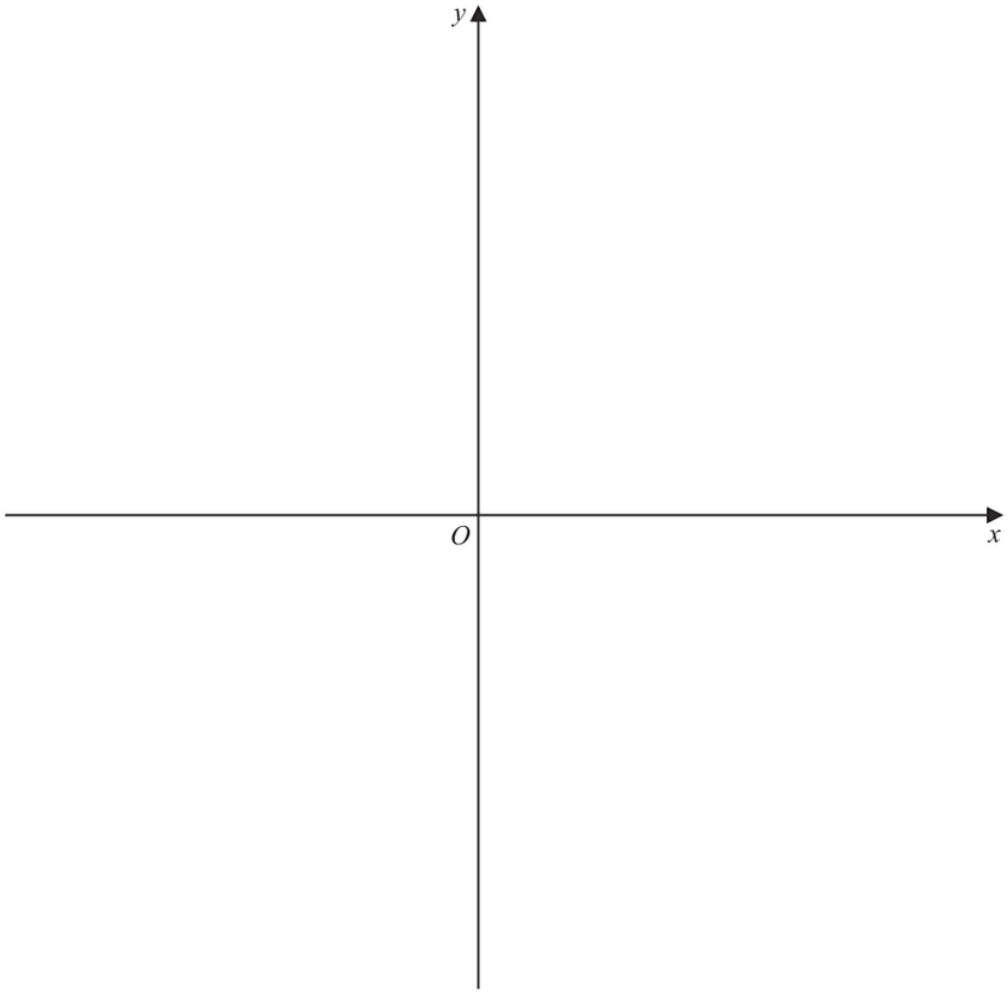
**25** (a) Write $28+24x-6x^2$ in the form $a-b(x-c)^2$ where $a$, $b$ and $c$ are integers.

.....

(3)

(b) On the axes below, sketch the graph of $y=28+24x-6x^2$

Show clearly the coordinates of the turning point and the coordinates of the point of intersection of the graph with the $y$-axis.




(3)

**(Total for Question 25 is 6 marks)**

# Question 25

5 marks | Completing the Square

**25** (a) Express $8 - 12x - 4x^2$ in the form $a - b(x + c)^2$
where $a$, $b$ and $c$ are constants.

.....

**(3)**

(b) Hence solve $8 - 12x - 4x^2 = 0$
Show your working clearly.
Give your solutions in surd form.

.....

**(2)**

**(Total for Question 25 is 5 marks)**

# Question 21

3 marks | Completing the Square

**21** Express $5x^2 - 20x + 23$ in the form $a(x - b)^2 + c$ where $a$, $b$ and $c$ are integers.

**(Total for Question 21 is 3 marks)**

# Question 22

2 marks | Completing the Square

**22** $9x^2 - 12x + q$ can be written in the form $(px - r)^2$ where $p$, $q$ and $r$ are integers.

Find the value of $q$

$q =$ .....

**(Total for Question 22 is 2 marks)**

# Question 24

3 marks | Completing the Square

**24** Express $5x^2 - 20x + 23$ in the form $a(x - b)^2 + c$ where $a$, $b$ and $c$ are integers.

**(Total for Question 24 is 3 marks)**

# Question 24

3 marks | Completing the Square

**24** Express $22 - 3x^2 + 30x$ in the form $a - b(x - c)^2$ where $a$, $b$ and $c$ are integers.

.....

**(Total for Question 24 is 3 marks)**

TOPIC

# Algebraic Proof

Every past-paper question on this topic, 2020 to 2026.

# Question 25

3 marks | Algebraic Proof

**25** $N$ is a multiple of 5

$A = N + 1$
$B = N - 1$

Prove, using algebra, that $A^2 - B^2$ is always a multiple of 20

**(Total for Question 25 is 3 marks)**

# Question 23

4 marks | Algebraic Proof

**23** Show that $\dfrac{16x^2 - 36}{x - 7} \div \dfrac{2x^2 + 7x + 6}{x^2 - 5x - 14} - (7 + 8x) = n$

where $n$ is an integer to be found.
Show clear algebraic working.

**(Total for Question 23 is 4 marks)**

4WM2/01 MAY 2025

# Question 20

3 marks | Algebraic Proof

**20** $a$, $b$ and $c$ are three consecutive even numbers where $a < b < c$

Prove algebraically that $b^2 = ac + 4$

**(Total for Question 20 is 3 marks)**

Dr Eslam Ahmed · eliteigcse.com

TOPIC

# Sequences

Every past-paper question on this topic, 2020 to 2026.

# Question 24

5 marks | Sequences

**24** The sum of the first 10 terms of an arithmetic series is 4 times the sum of the first 5 terms of the same series.
The 8th term of this series is 45

Find the first term of this series.
Show clear algebraic working.

.....

**(Total for Question 24 is 5 marks)**

# Question 22

4 marks | Sequences

**22** The first term of an arithmetic series $S$ is $-6$
The sum of the first 30 terms of $S$ is 2865

Find the 9th term of $S$.

**(Total for Question 22 is 4 marks)**

# Question 25

3 marks | Sequences

**25** Mario is going to save \$50 in the year 2021

He is going to continue to save, up to and including the year 2070, by increasing the amount he saves each year by \$$k$

Mario will save a total of \$33 125 from 2021 to 2070

Work out the value of $k$.

$k =$ .....

**(Total for Question 25 is 3 marks)**

# Question 24

4 marks | Sequences

**24** Here are the first five terms of an arithmetic sequence.

8 15 22 29 36

Work out the sum of all the terms from the 50th term to the 100th term inclusive.

**(Total for Question 24 is 4 marks)**

# Question 21

6 marks | Sequences

**21** The $n$th term of an arithmetic series is $u_n$ where $u_n > 0$ for all $n$
The sum to $n$ terms of the series is $S_n$

Given that $u_4 = 6$ and that $S_{11} = (u_6)^2 + 18$

find the value of $u_{20}$

**(Total for Question 21 is 6 marks)**

# Question 24

4 marks | Sequences

**24** An arithmetic series has first term $a$ and common difference $d$.

The sum of the first $2n$ terms of the series is four times the sum of the first $n$ terms of the series.

Find an expression for $a$ in terms of $d$.
Show your working clearly.

$a =$ .....

**(Total for Question 24 is 4 marks)**

# Question 23

5 marks | Sequences

**23** The sum of the first $N$ terms of an arithmetic series, $S$, is 292
The 2nd term of $S$ is 8.5
The 5th term of $S$ is 13

Find the value of $N$.
Show clear algebraic working.

$N =$ .....

**(Total for Question 23 is 5 marks)**

# Question 20

5 marks | Sequences

**20** Here are the first four terms of an arithmetic series.

$$k \quad \frac{3k}{4} \quad \frac{k}{2} \quad \frac{k}{4}$$

Given that the 15th term of the series is $(90 + 2k)$,

calculate the sum of the first 30 terms of the series.

**(Total for Question 20 is 5 marks)**

# Question 26

5 marks | Sequences

**26** An arithmetic series has first term $a$ and common difference $d$, where $d$ is a prime number.

The sum of the first $n$ terms of the series is $S_n$ and

$S_m = 39$

$S_{2m} = 320$

Find the value of $d$ and the value of $m$
Show clear algebraic working.

$d =$ .....

$m =$ .....

**(Total for Question 26 is 5 marks)**

# Question 25

5 marks | Sequences

**25** The sum of the first 10 terms of an arithmetic series is 4 times the sum of the first 5 terms of the same series.

The 8th term of this series is 45

Find the first term of this series.
Show clear algebraic working.

**(Total for Question 25 is 5 marks)**

# Question 20

6 marks | Sequences

**20** The sum of the first 80 terms of an arithmetic series, $S$, is 470

The 75th term of $S$ is 14.5

The sum of the first $X$ terms of $S$ is 171

Work out the value of $X$
Show your working clearly.

$X =$ .....

**(Total for Question 20 is 6 marks)**

# Question 23

5 marks | Sequences

**23** Here are the first three terms of an arithmetic sequence.

$$8p \qquad 7p - 3 \qquad 4p + 2$$

The sum of the first $n$ terms of the sequence is $-1914$

Work out the value of $n$
Show your working clearly.

$n =$ .....

**(Total for Question 23 is 5 marks)**

# Question 23

4 marks | Sequences

**23** Here are the first three terms of an arithmetic sequence.

$$(4x-14) \quad , \quad (x+2) \quad , \quad (7x-9)$$

Find, as an integer, the sum of the first 40 terms of the sequence.
Show clear algebraic working.

**(Total for Question 23 is 4 marks)**

# Question 24

6 marks | Sequences

**24** A polygon has $n$ sides, where $n > 5$

The interior angles of the polygon form an arithmetic sequence.

The smallest angle of the polygon is 84°
The common difference of the sequence is 4°

Work out the sum of the interior angles of the polygon.
Show clear algebraic working.

.....°

**(Total for Question 24 is 6 marks)**

# Question 24

5 marks | Sequences

**24** An arithmetic series has 30 terms.

The first term is $a$
The common difference is $d$

The 20th term is 123
The sum of the 30 terms is 2880

Work out the value of $a$ and the value of $d$
Show clear algebraic working.

$a =$ .....

$d =$ .....

**(Total for Question 24 is 5 marks)**

# Question 24

6 marks | Sequences

**24** The first 3 terms of an arithmetic series are

$$(2x + 5) \qquad (3y - 4) \qquad (4x - 2)$$

where $x$ and $y$ are constants.

The sum of the first 9 terms of the series is 216

Find the value of $x$ and the value of $y$
Show clear algebraic working.

$x =$ .....

$y =$ .....

**(Total for Question 24 is 6 marks)**

# Question 24

4 marks | Sequences

**24** The 21st term of an arithmetic series is 109
The sum of the first 52 terms of the series is 4381

Work out the 5th term of the series.
Show clear algebraic working.

.....

**(Total for Question 24 is 4 marks)**

# Question 24

6 marks | Sequences

**24** An arithmetic series $P$ has first term $a$ and common difference $d$

The sum of the first 40 terms of $P$ is 2070

An arithmetic series $Q$ has first term $2a$ and common difference $3d$

The 25th term of $Q$ is 186

Work out the sum of the first 40 terms of $Q$
Show clear algebraic working.

**(Total for Question 24 is 6 marks)**

# Question 25

5 marks | Sequences

**25** The first term of an arithmetic series is 10
The 20th term of the series is 86

The sum of the first $N$ terms of the series is 5194

Work out the value of $N$
Show your working clearly.

$N =$ .....

**(Total for Question 25 is 5 marks)**

# Question 26

5 marks | Sequences

**26** The first term of an arithmetic series is 10
The 20th term of the series is 86

The sum of the first $N$ terms of the series is 5194

Work out the value of $N$
Show your working clearly.

$N =$ .....

**(Total for Question 26 is 5 marks)**

# Question 25

6 marks | Sequences

**25** Here are the first four terms of an arithmetic series.

$$(k + 2) \qquad (k + 5) \qquad (k + 8) \qquad (k + 11)$$

The sum of the first $2n$ terms of the series is 4 times the sum of the first $n$ terms of the series.

Work out the numerical value of the 100th term of the series.
Show your working clearly.

**(Total for Question 25 is 6 marks)**

TOPIC

# Direct & Inverse Proportion

Every past-paper question on this topic, 2020 to 2026.

4MA1/2HR JANUARY 2022

# Question 20

4 marks | Direct & Inverse Proportion

**20** $y$ is inversely proportional to $\sqrt{x}$
$x$ is directly proportional to $T^3$

Given that $y = 8$ when $T = 25$

find the exact value of $T$ when $y = 27$

$T =$ .....

**(Total for Question 20 is 4 marks)**



TOPIC

# Linear Graphs

Every past-paper question on this topic, 2020 to 2026.

# Question 23

6 marks | Linear Graphs

**23** $ABCD$ is a kite.

$AB = AD$ and $CB = CD$

The point $B$ has coordinates $(k, 1)$ where $k$ is a negative constant.
The point $D$ has coordinates $(8, 7)$

The straight line **L** passes through the points $B$ and $D$ and has a gradient of $\frac{3}{5}$

Find an equation of $AC$
Give your answer in the form $px + qy = r$ where $p$, $q$ and $r$ are integers.
Show your working clearly.

.....

**(Total for Question 23 is 6 marks)**

# Question 22

6 marks | Linear Graphs

**22** Triangle $HJK$ is isosceles with $HJ = HK$ and $JK = \sqrt{80}$

$H$ is the point with coordinates $(-4, 1)$
$J$ is the point with coordinates $(j, 15)$ where $j < 0$
$K$ is the point with coordinates $(6, k)$

$M$ is the midpoint of $JK$.
The gradient of $HM$ is 2

Find the value of $j$ and the value of $k$.

$j =$ .....

$k =$ .....

**(Total for Question 22 is 6 marks)**

# Question 22

5 marks | Linear Graphs

**22** The line with equation $y = x + 2$ intersects the curve with equation $x^2 + y^2 - 2y = 24$ at the points $A$ and $B$.

Find the coordinates of $A$ and $B$.
Show clear algebraic working.

(..... , .....)

(..... , .....)

**(Total for Question 22 is 5 marks)**

# Question 24

5 marks | Linear Graphs

**24** $\mathbf{L}_1$ and $\mathbf{L}_2$ are two straight lines.
The origin of the coordinate axes is $O$.

$\mathbf{L}_1$ has equation $5x + 10y = 8$
$\mathbf{L}_2$ is perpendicular to $\mathbf{L}_1$ and passes through the point with coordinates (8, 6)

$\mathbf{L}_2$ crosses the $x$-axis at the point $A$.
$\mathbf{L}_2$ intersects the straight line with equation $x = -3$ at the point $B$.

Find the area of triangle $AOB$.
Show your working clearly.

**(Total for Question 24 is 5 marks)**

# Question 22

4 marks | Linear Graphs

**22** $ABCD$ is a rhombus.

The diagonals, $AC$ and $BD$, intersect at the point $M$.
The coordinates of $M$ are $(6, -11)$

The points $A$ and $C$ both lie on the line with equation $2y + 7x = 20$

Find the exact coordinates of the point where the line through $B$ and $D$ intersects the $y$-axis.

(..... , .....)

**(Total for Question 22 is 4 marks)**

# Question 22

5 marks | Linear Graphs

**22** $ABC$ is an isosceles triangle with $AB = AC$.

$B$ is the point with coordinates $(-1, 5)$
$C$ is the point with coordinates $(2, 10)$
$M$ is the midpoint of $BC$.

Find an equation of the line through the points $A$ and $M$.
Give your answer in the form $py + qx = r$ where $p$, $q$ and $r$ are integers.

**(Total for Question 22 is 5 marks)**

# Question 20

7 marks | Linear Graphs

**20** The straight line **L** passes through point $A$ $(-6, 2)$ and point $B$ $(5, 3)$
The straight line **M** is perpendicular to **L** and passes through the midpoint of $A$ and $B$.
The line **M** intersects the line $x = -1$ at point $C$.

Calculate the area of triangle $ABC$.

**(Total for Question 20 is 7 marks)**

# Question 22

5 marks | Linear Graphs

**22** $ABC$ is a triangle in which angle $ABC = 90°$

$p$ and $q$ are integers such that

the coordinates of $A$ are $(p, 10)$
the coordinates of $B$ are $(-1, -5)$
the coordinates of $C$ are $(8, q)$

Given that the gradient of $AC$ is $-\frac{6}{7}$

work out the value of $p$ and the value of $q$

$p =$ .....

$q =$ .....

**(Total for Question 22 is 5 marks)**

# Question 20

4 marks | Linear Graphs

**20** The centre $O$ of a circle has coordinates (4, 7)

The point $A$, on the circle, has coordinates (6, 11) and $AOP$ is a diameter of the circle.

Find an equation of the tangent to the circle at the point $P$

**(Total for Question 20 is 4 marks)**

# Question 22

7 marks | Linear Graphs

**22** $ABCD$ is a kite, with diagonals $AC$ and $BD$, drawn on a centimetre square grid, with a scale of 1 cm for 1 unit on each axis.

$A$ is the point with coordinates $(-3, 4)$

The diagonals of the kite intersect at the point $M$ with coordinates $(0, 2)$

Given that $AB = AD = 6.5$ cm and the $x$ coordinate of $B$ is positive,

find the coordinates of the points $B$ and $D$.

(..... , .....)

(..... , .....)

**(Total for Question 22 is 7 marks)**

4MA1/2HR JUNE 2023

# Question 21

5 marks | Linear Graphs

**21** Work out the coordinates of the points of intersection of

$$y - 2x = 1 \quad \text{and} \quad y^2 + xy = 7$$

Show clear algebraic working.

(..... , .....)

(..... , .....)

**(Total for Question 21 is 5 marks)**

# Question 24

6 marks | Linear Graphs

**24** $ABCD$ is a kite with $AB = AD$ and $CB = CD$

$A$ is the point with coordinates $(-2, 10)$

$B$ is the point with coordinates $\left(-\frac{27}{5}, 4\right)$

$C$ is the point with coordinates $(4, -5)$

Work out the coordinates of $D$

(..... , .....)

**(Total for Question 24 is 6 marks)**

# Question 25

6 marks | Linear Graphs

**25** The straight line with equation $y - 2x = 7$ is the perpendicular bisector of the line $AB$ where $A$ is the point with coordinates $(j, 7)$ and $B$ is the point with coordinates $(6, k)$

Find the coordinates of the midpoint of the line $AB$
Show clear algebraic working.

(..... , .....)

**(Total for Question 25 is 6 marks)**

# Question 21

5 marks | Linear Graphs

**21** The line with equation $x + 2y = 5$ intersects the curve with equation $x^2 + 3y^2 = 13$ at the points $A$ and $B$

Find the coordinates of $A$ and the coordinates of $B$
Show clear algebraic working.

(..... , .....)

(..... , .....)

**(Total for Question 21 is 5 marks)**

# Question 22

6 marks | Linear Graphs

**22** [In this question 1 cm = 1 unit on the $x$-axis and 1 cm = 1 unit on the $y$-axis]

$P$ is a point on a circle with centre (0, 0)
The coordinates of $P$ are (8, −10)

The line **L** is the tangent to the circle at the point $P$
**L** crosses the $x$-axis at the point $Q$ and crosses the $y$-axis at the point $R$

Work out the length of $RQ$
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 22 is 6 marks)**

# Question 21

4 marks | Linear Graphs

**21** $ABCD$ is a square.

The point $A$ has coordinates $(-5, 2)$
The point $B$ has coordinates $(3, 5)$

Find an equation of the line that passes through $B$ and $C$
Give your answer in the form $ax + by + c = 0$ where $a$, $b$ and $c$ are integers.

**(Total for Question 21 is 4 marks)**

# Question 22

5 marks | Linear Graphs

**22** The straight line **L** has equation $x + y = 5$

The curve **C** has equation $2x^2 + 3y^2 = 210$

Find the coordinates of the points where **L** and **C** intersect.
Show clear algebraic working.

(..... , .....) (..... , .....)

**(Total for Question 22 is 5 marks)**

# Question 23

5 marks | Linear Graphs

**23** A circle $C$ has centre $(3q, 4q)$ where $q$ is an integer.

The straight line with equation $y = -\frac{5}{4}x + \frac{21}{4}$ is the tangent to $C$ at the point $(p, p+3)$ where $p$ is an integer.

Work out the radius of $C$
Give your answer in the form $\sqrt{a}$ where $a$ is an integer.
Show your working clearly.

**(Total for Question 23 is 5 marks)**

# Question 24

6 marks | Linear Graphs

**24** $PQ$ is a straight line drawn on a square grid, with a scale of 1 cm for 1 unit on each axis.

$P$ has coordinates $(-5, a)$ and $Q$ has coordinates $(7, 3a)$ where $a > 0$

The length of $PQ$ is $4\sqrt{10}$ cm

Find an equation of the perpendicular bisector of $PQ$
Give your answer in the form $y = mx + c$ where $m$ and $c$ are integers.

**(Total for Question 24 is 6 marks)**

# Question 24

5 marks | Linear Graphs

**24** $PQRS$ is a square.

$PR$ is a diagonal of the square.

$P$ is the point with coordinates (4, 7)
$R$ is the point with coordinates (8, –5)

Find an equation of the straight line that passes through the points $Q$ and $S$
Give your answer in the form $ay = bx + c$ where $a$, $b$ and $c$ are integers.

**(Total for Question 24 is 5 marks)**

# Question 25

5 marks | Linear Graphs

**25** $PQRS$ is a square.

$PR$ is a diagonal of the square.

$P$ is the point with coordinates (4, 7)
$R$ is the point with coordinates (8, –5)

Find an equation of the straight line that passes through the points $Q$ and $S$
Give your answer in the form $ay = bx + c$ where $a$, $b$ and $c$ are integers.

**(Total for Question 25 is 5 marks)**

# Question 20

3 marks | Linear Graphs

**20** The straight line **L** has equation $y = 4x + 7$

The straight line **M** is perpendicular to **L** and passes through the point with coordinates (8, 1)

Find an equation for **M**
Give your answer in the form $y = mx + c$

**(Total for Question 20 is 3 marks)**

# Question 27

5 marks | Linear Graphs

**27** $ABCD$ is a rhombus with $AB = BC = CD = DA$

$A$ has coordinates $(16, -9)$

$C$ has coordinates $(24, 15)$

Find an equation of the line $BD$
Give your answer in the form $ax + by + c = 0$ where $a$, $b$ and $c$ are integers.
Show your working clearly.

**(Total for Question 27 is 5 marks)**

# Question 28

6 marks | Linear Graphs

**28** The curve **C** has equation $x^2 + y^2 = d - 11x$ where $d$ is an integer.
The line **L** has equation $y = 3x + e$ where $e$ is an integer.

**C** and **L** intersect at the point $A$ and at the point $B$

The coordinates of $A$ are (0.2, 2.6)

Work out the coordinates of $B$
Show your working clearly.

(..... , .....)

**(Total for Question 28 is 6 marks)**



TOPIC

# Graphs of Functions

Every past-paper question on this topic, 2020 to 2026.

# Question 20

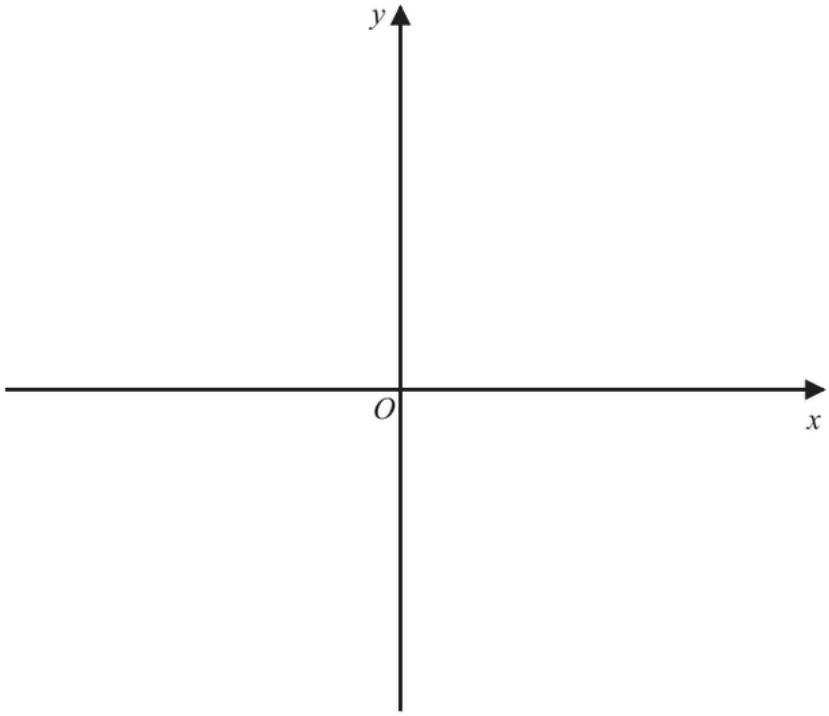
4 marks | Graphs of Functions

**20** The curve **C** has equation $y = 4(x - 1)^2 - a$ where $a > 4$

Using the axes below, sketch the curve **C**.
On your sketch show clearly, in terms of $a$,

(i) the coordinates of any points of intersection of **C** with the coordinate axes,

(ii) the coordinates of the turning point.

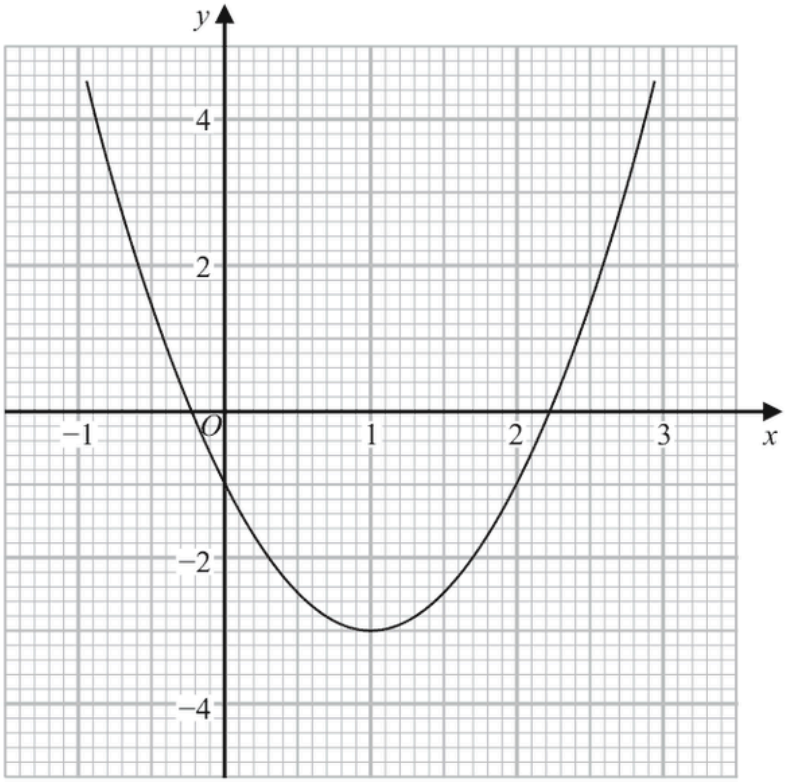



**(Total for Question 20 is 4 marks)**

# Question 21

5 marks | Graphs of Functions

**21** Part of the graph of $y = 2x^2 - 4x - 1$ is shown on the grid.




(a) Use the graph to find estimates for the solutions of the equation $2x^2 - 4x - 1 = 0$
Give your solutions correct to one decimal place.

.....

**(2)**

(b) By drawing a suitable straight line on the grid, find estimates for the solutions of the equation $x^2 - x - 1 = 0$
Show your working clearly.
Give your solutions correct to one decimal place.

.....

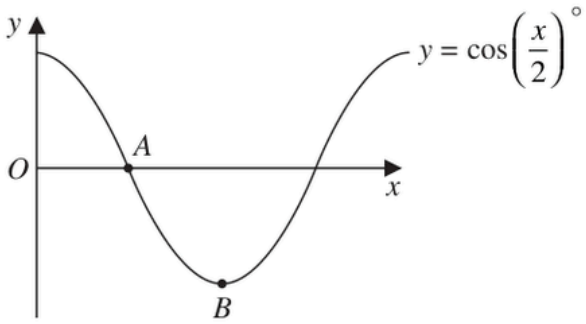
**(3)**

**(Total for Question 21 is 5 marks)**

# Question 23

2 marks | Graphs of Functions

**23** The diagram shows a sketch of the graph of $y = \cos\left(\frac{x}{2}\right)^\circ$




(i) Find the coordinates of the point $A$

(.....  ,  .....)

**(1)**

(ii) Find the coordinates of the point $B$

(.....  ,  .....)

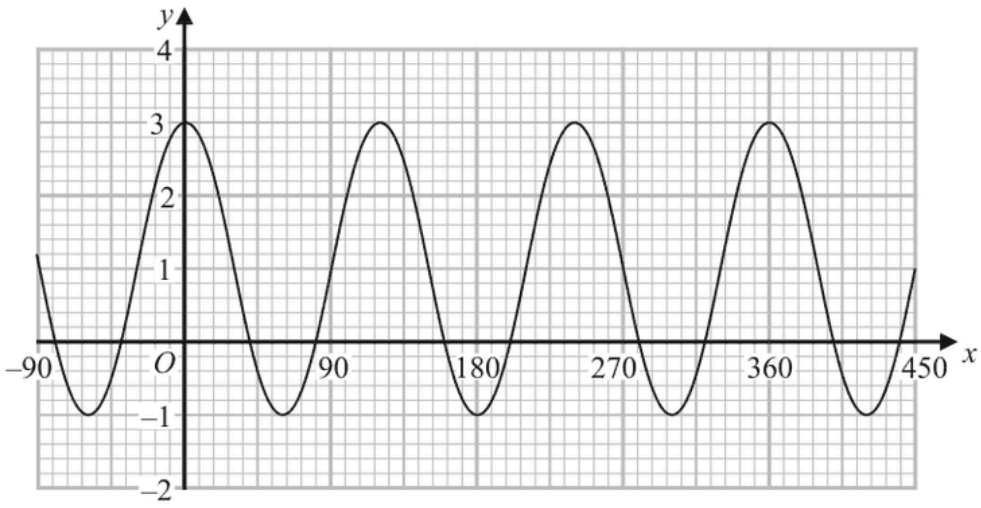
**(1)**

**(Total for Question 23 is 2 marks)**

# Question 26

3 marks | Graphs of Functions

**26** Here is a sketch of the curve with equation $y = a\cos bx° + c$ where $-90 \leqslant x \leqslant 450$




Find the value of $a$, the value of $b$ and the value of $c$

$a =$ .....

$b =$ .....

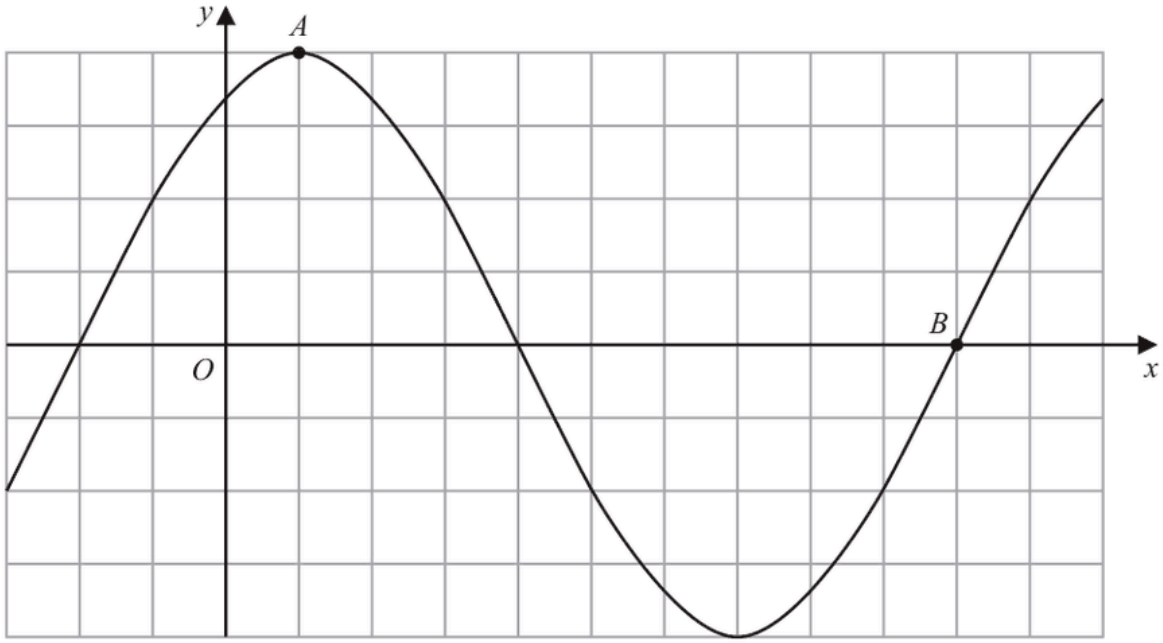
$c =$ .....

**(Total for Question 26 is 3 marks)**

# Question 25

2 marks | Graphs of Functions

**25** The diagram shows a sketch of the graph of $y = 2\sin(x + 60)°$




(i) Find the coordinates of the point $A$

(..... , .....)

**(1)**

(ii) Find the coordinates of the point $B$

(..... , .....)

**(1)**

**(Total for Question 25 is 2 marks)**

# Question 23

5 marks | Graphs of Functions

**23** The curve **C** has equation $y = x^2 - 8x - 9$
The straight line **L** has equation $y = k$ where $k$ is an integer.

**C** and **L** intersect at the points $A$ and $B$

The coordinates of point $A$ are $(p, k)$
The coordinates of point $B$ are $(q, k)$

Given that $p - q = 14$

find the value of $k$
Show clear algebraic working.

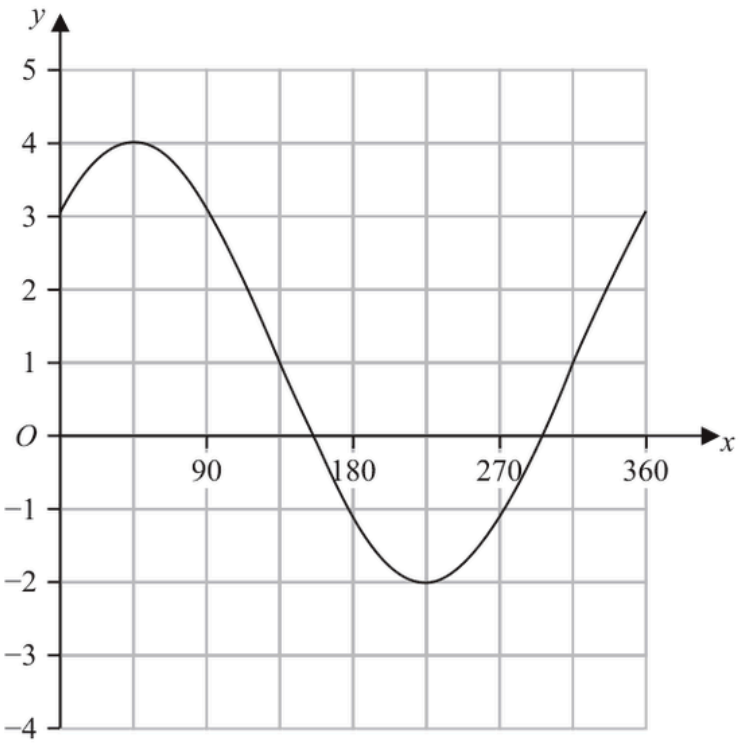
$k =$ .....

**(Total for Question 23 is 5 marks)**

# Question 23

3 marks | Graphs of Functions

**23** The graph of $y = a\sin(x + b)^\circ + c$ for $0 \leqslant x \leqslant 360$ is drawn on the grid below.




Find a suitable value for $a$, for $b$ and for $c$

$a =$ .....

$b =$ .....

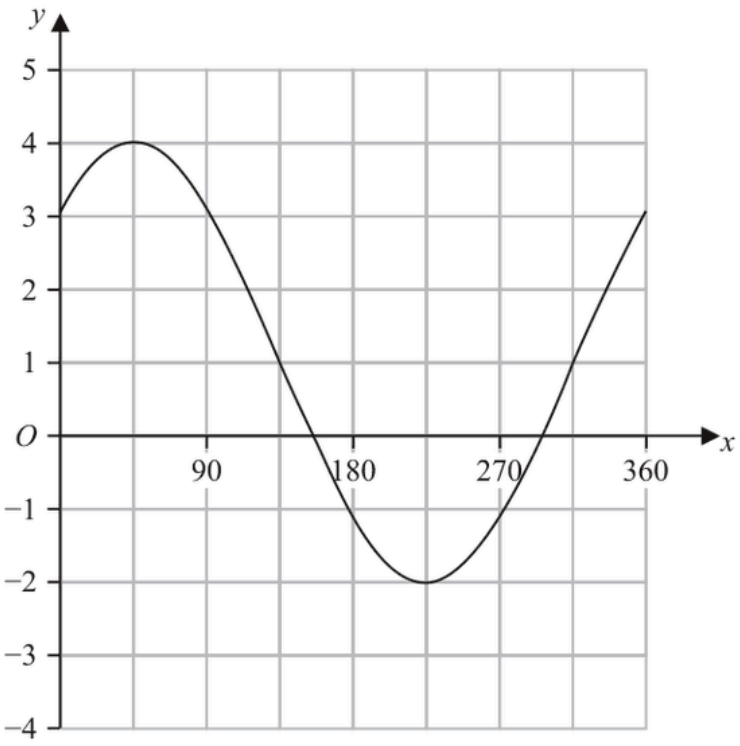
$c =$ .....

**(Total for Question 23 is 3 marks)**

# Question 25

3 marks | Graphs of Functions

**25** The graph of $y = a\sin(x + b)^\circ + c$ for $0 \leqslant x \leqslant 360$ is drawn on the grid below.




Find a suitable value for $a$, for $b$ and for $c$

$a =$ .....

$b =$ .....

$c =$ .....

**(Total for Question 25 is 3 marks)**

# Question 25

3 marks | Graphs of Functions

**25** A curve has equation $y = f(x)$

There is one minimum point on this curve.

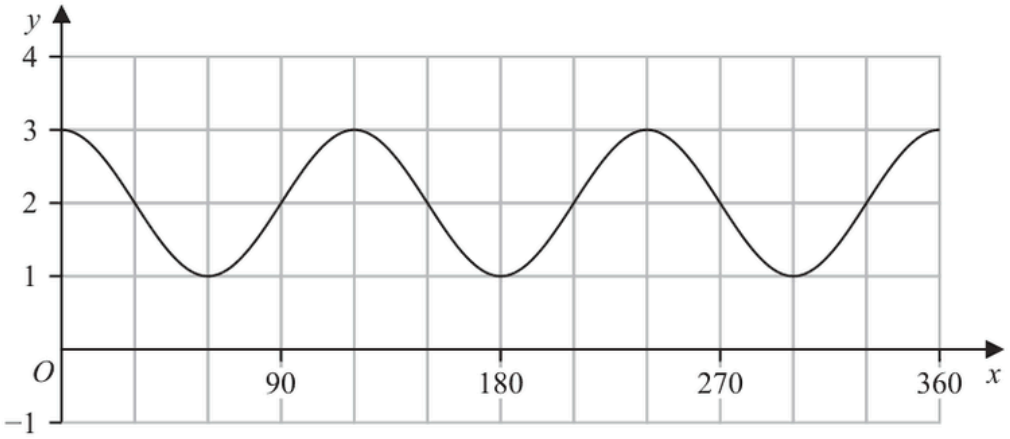
The coordinates of this minimum point are $(8, 1)$

(a) Write down the coordinates of the minimum point on the curve with equation $y = f(4x)$

(.....  , .....)

**(1)**

The diagram shows the graph of $y = \cos(ax) + b$ for $0 \leqslant x \leqslant 360$




(b) (i) Find the value of $a$

$a =$ .....

**(1)**

(ii) Find the value of $b$

$b =$ .....

**(1)**

**(Total for Question 25 is 3 marks)**

TOPIC

# Functions

Every past-paper question on this topic, 2020 to 2026.

# Question 21

5 marks | Functions

**21** The functions f and g are such that

$$f(x) = x^2 - 2x \qquad g(x) = x + 3$$

The function h is such that $h(x) = fg(x)$ for $x \geqslant -2$

Express the inverse function $h^{-1}(x)$ in the form $h^{-1}(x) = \ldots$

$h^{-1}(x) =$ .....

**(Total for Question 21 is 5 marks)**

# Question 22

3 marks | Functions

**22** The function f is such that $f(x) = x^2 - 8x + 5$ where $x \leqslant 4$

Express the inverse function $f^{-1}$ in the form $f^{-1}(x) = ...$

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

**(Total for Question 22 is 3 marks)**

# Question 24

6 marks | Functions

**24** The functions f and g are defined as

$$f(x) = 5x^2 - 10x + 7 \qquad \text{where } x \geqslant 1$$

$$g(x) = 7x - 6$$

(a) Find fg(2)

.....

**(2)**

(b) Express the inverse function $f^{-1}$ in the form $f^{-1}(x) = ...$

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

**(4)**

**(Total for Question 24 is 6 marks)**

# Question 23

4 marks | Functions

**23** The functions f and g are such that

$$f(x) = x + 25 \qquad g(x) = x^2 - 12x$$

The function h is such that $h(x) = fg(x)$

The domain of h is $\{x : x \leqslant 6\}$

Express the inverse function $h^{-1}$ in the form $h^{-1}(x) = ...$

$h^{-1}(x) =$ .....

**(Total for Question 23 is 4 marks)**

# Question 25

5 marks | Functions

**25** The function g is defined as

$$g: x \mapsto 5 + 6x - x^2 \quad \text{with domain} \quad \{x : x \geqslant 3\}$$

(a) Express the inverse function $g^{-1}$ in the form $g^{-1}: x \mapsto \ldots$

$g^{-1}: x \mapsto$ .....

**(4)**

(b) State the domain of $g^{-1}$

.....

**(1)**

**(Total for Question 25 is 5 marks)**

# Question 25

4 marks | Functions

**25** The function f is such that $f(x) = 2x^2 - 24x + 7$ where $x \geqslant 6$

Find the inverse function $f^{-1}(x)$

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

**(Total for Question 25 is 4 marks)**

# Question 21

7 marks | Functions

**21** The function g is defined as

$$g(x) = \frac{7x + 20}{2x} \qquad x \neq 0$$

(a) Solve gg $(x) = 6$
Show clear algebraic working.

$x =$ .....

**(3)**

P81641A
©2025 Pearson Education Ltd

The function h is defined as

$$h(x) = 5x^2 + 30x - 7 \qquad x \geqslant -3$$

(b) Express the inverse function $h^{-1}$ in the form $h^{-1}(x) = \ldots$

$h^{-1}(x) =$ .....

**(4)**

**(Total for Question 21 is 7 marks)**

# Question 21

7 marks | Functions

**21** The functions f and g are defined as

$$f(x) = 5x - 3$$

$$g(x) = 4x^2 + 16x - 9 \qquad \text{where} \quad x \geqslant -2$$

(a) Find g( –1)

.....

**(1)**

(b) Find fg($x$)

Give your answer in its simplest form.

fg($x$) = .....

**(2)**

---

$g(x) = 4x^2 + 16x - 9$ where $x \geqslant -2$

(c) Express the inverse function $g^{-1}$ in the form $g^{-1}(x) = ...$

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

**(4)**

**(Total for Question 21 is 7 marks)**

TOPIC

# Differentiation & Turning Points

Every past-paper question on this topic, 2020 to 2026.

# Question 23

6 marks | Differentiation & Turning Points

**23** A particle moves along a straight line.
The fixed point $O$ lies on this line.
The displacement of the particle from $O$ at time $t$ seconds, $t \geqslant 0$, is $s$ metres where

$$s = t^3 + 4t^2 - 5t + 7$$

At time $T$ seconds the velocity of $P$ is $V$ m/s where $V \geqslant -5$

Find an expression for $T$ in terms of $V$.

Give your expression in the form $\dfrac{-4 + \sqrt{k + mV}}{3}$ where $k$ and $m$ are integers to be found.

$T =$ .....

**(Total for Question 23 is 6 marks)**

# Question 23

4 marks | Differentiation & Turning Points

**23** Curve **C** has equation $y = px^3 - mx$ where $p$ and $m$ are positive integers.

Find the range of values of $x$, in terms of $p$ and $m$, for which the gradient of **C** is negative.

**(Total for Question 23 is 4 marks)**

# Question 20

5 marks | Differentiation & Turning Points

**20** A particle $P$ is moving along a straight line.
The fixed point $O$ lies on the line.

At time $t$ seconds ($t \geqslant 0$), the displacement of $P$ from $O$ is $s$ metres where

$$s = t^3 - 9t^2 + 33t - 6$$

Find the minimum speed of $P$.

..... m/s

**(Total for Question 20 is 5 marks)**

# Question 21

5 marks | Differentiation & Turning Points

**21** The point $A$ is the only stationary point on the curve with equation $y = kx^2 + \frac{16}{x}$ where $k$ is a constant.

Given that the coordinates of $A$ are $\left(\frac{2}{3}, a\right)$

find the value of $a$.
Show your working clearly.

$a =$ .....

**(Total for Question 21 is 5 marks)**

# Question 23

6 marks | Differentiation & Turning Points

**23** 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.

**(Total for Question 23 is 6 marks)**

# Question 24

6 marks | Differentiation & Turning Points

**24** The curve **C** has equation $y = ax^3 + bx^2 - 12x + 6$ where $a$ and $b$ are constants.

The point $A$ with coordinates $(2, -6)$ lies on **C**
The gradient of the curve at $A$ is 16

Find the $y$ coordinate of the point on the curve whose $x$ coordinate is 3
Show clear algebraic working.

$y =$ .....

**(Total for Question 24 is 6 marks)**

# Question 24

5 marks | Differentiation & Turning Points

**24** A particle $P$ moves along a straight line that passes through the fixed point $O$

The displacement, $x$ metres, of $P$ from $O$ at time $t$ seconds, where $t \geqslant 0$, is given by

$$x = 4t^3 - 27t + 8$$

The direction of motion of $P$ reverses when $P$ is at the point $A$ on the line.

The acceleration of $P$ at the instant when $P$ is at $A$ is $a\ \text{m/s}^2$

Find the value of $a$

$a =$ .....

**(Total for Question 24 is 5 marks)**

# Question 22

7 marks | Differentiation & Turning Points

**22** The diagram shows a sketch of part of the curve with equation $y = x^2 - \frac{p}{x}$ where $p$ is a positive constant.

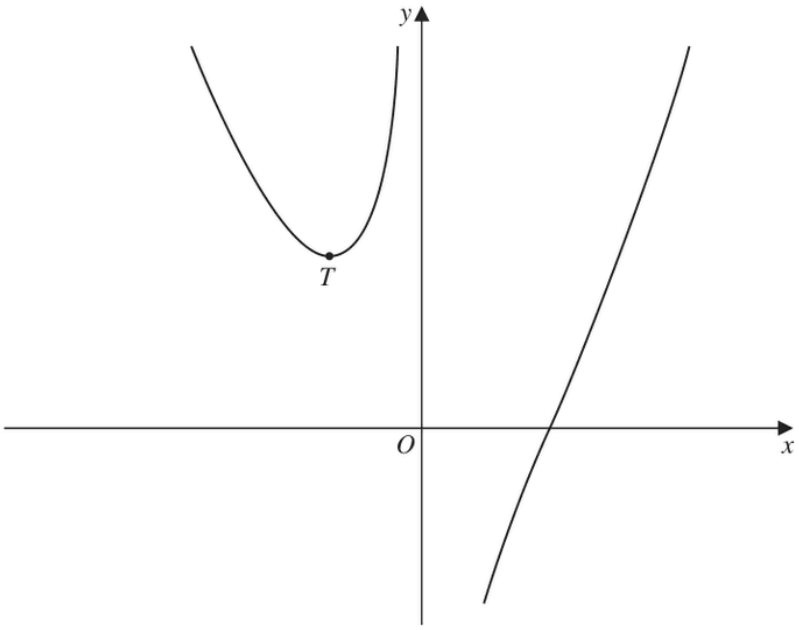



Diagram **NOT** accurately drawn

For all values of $p$, the curve has exactly one turning point and this turning point is a minimum shown as the point $T$ in the sketch.

For the curve where the $x$ coordinate of $T$ is $-3$

(a) find the value of $p$

$p =$ .....

**(4)**

The line with equation $y = k$ is a tangent to the curve with equation $y = x^2 - \frac{16}{x}$

(b) Find the value of $k$

$k =$ .....

**(3)**

**(Total for Question 22 is 7 marks)**

# Question 21

6 marks | Differentiation & Turning Points

**21** The curve **T** has equation $y = x^3 - 2x^2 - 9x + 15$

(a) Find $\frac{dy}{dx}$

$\frac{dy}{dx} =$ .....

**(2)**

(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.

**(4)**

**(Total for Question 21 is 6 marks)**

# Question 20

4 marks | Differentiation & Turning Points

**20** The curve with equation $y = 2x^4 - 64x$ has a minimum point.

Find an equation of the tangent to the curve at the minimum point.
Show clear algebraic working.

**(Total for Question 20 is 4 marks)**

# Question 22

5 marks | Differentiation & Turning Points

**22** The diagram shows a solid cuboid.

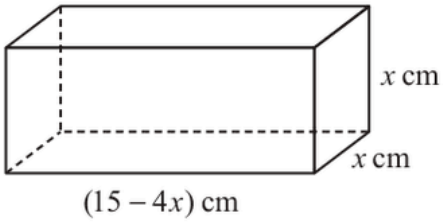



Diagram **NOT** accurately drawn

The volume of the cuboid is $V$ cm$^3$

Find the maximum value of $V$

**(Total for Question 22 is 5 marks)**

# Question 22

4 marks | Differentiation & Turning Points

**22** Work out the range of values of $x$ for which the graph of $y = x^3 + \frac{2}{}x^2 - 10x + 5$ has a positive gradient.
Show clear algebraic working.

.....

**(Total for Question 22 is 4 marks)**

# Question 22

6 marks | Differentiation & Turning Points

**22** Curve **C** has equation $y = x^3 - 16x + 7$

At two points on **C**, the gradient is 11
The tangents to **C** at these two points have equations of the form $y = ax + b$

Work out the two possible values of $b$
Show clear algebraic working.

**(Total for Question 22 is 6 marks)**

# Question 22

6 marks | Differentiation & Turning Points

**22** Curve **C** has equation $y = x^3 - 16x + 7$

At two points on **C**, the gradient is 11
The tangents to **C** at these two points have equations of the form $y = ax + b$

Work out the two possible values of $b$
Show clear algebraic working.

**(Total for Question 22 is 6 marks)**

# Question 23

5 marks | Differentiation & Turning Points

**23** A particle is moving along a straight line that passes through the fixed point $O$

The displacement, $s$ metres, of the particle from $O$ at time $t$ seconds is given by

$$s = 15t^2 - t^3 + 12$$

Find the maximum velocity of the particle where $0 < t < 11$
Show clear algebraic working.

..... m/s

**(Total for Question 23 is 5 marks)**

TOPIC

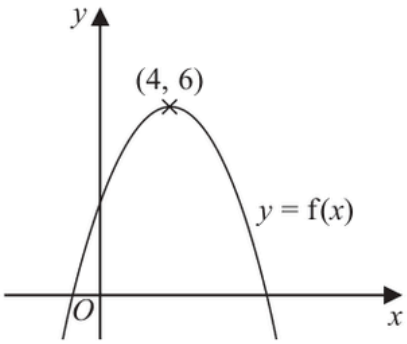
# Transformations of Graphs

Every past-paper question on this topic, 2020 to 2026.

# Question 21

4 marks | Transformations of Graphs

**21** The diagram shows a sketch of part of the curve with equation $y = f(x)$




There is one maximum point on this curve.
The coordinates of this maximum point are (4, 6)

(a) Write down the coordinates of the maximum point on the curve with equation

(i) $y = f(x + 4)$

(.....  ,  .....)

(ii) $y = f(2x)$

(.....  ,  .....)

**(2)**

The equation of a curve **C** is $y = x^2 + 3x + 4$

The curve **C** is transformed to curve **S** under the translation $\begin{pmatrix} 4 \\ 6 \end{pmatrix}$

(b) Find an equation of curve **S**.

*You do not need to simplify the equation.*

.....

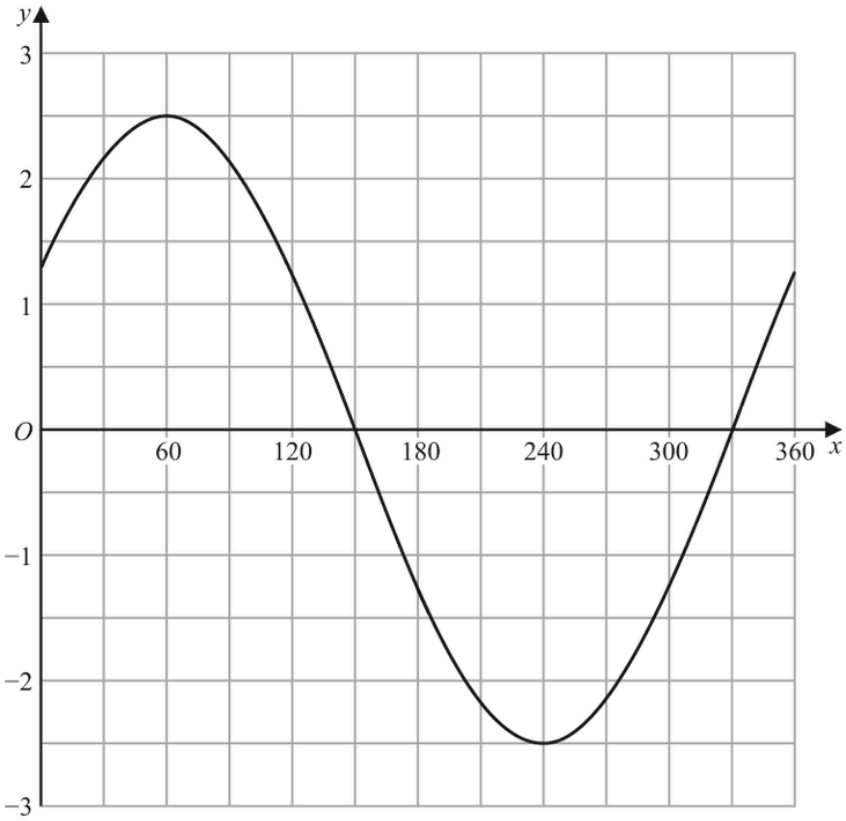
**(2)**

**(Total for Question 21 is 4 marks)**

# Question 22

4 marks | Transformations of Graphs

**22** The graph of $y = a\cos(x + b)°$ for $0 \leqslant x \leqslant 360$ is drawn on the grid.




(a) Find the value of $a$ and the value of $b$.

$a =$ .....

$b =$ .....

**(2)**

Another curve $C$ has equation $y = f(x)$
The coordinates of the minimum point of $C$ are (4, 5)

(b) Write down the coordinates of the minimum point of the curve with equation

(i) $y = f(2x)$

(..... , .....)

(ii) $y = f(x) - 7$

(..... , .....)

**(2)**

**(Total for Question 22 is 4 marks)**

# Question 20

2 marks | Transformations of Graphs

**20** A curve has equation $y = f(x)$
There is only one maximum point on the curve.
The coordinates of this maximum point are $(-3, 4)$

Write down the coordinates of the maximum point on the curve with equation

(i) $y = f(x) - 6$

(.....  , .....)

(ii) $y = f(2x)$

(.....  , .....)

**(Total for Question 20 is 2 marks)**

# Question 25

3 marks | Transformations of Graphs

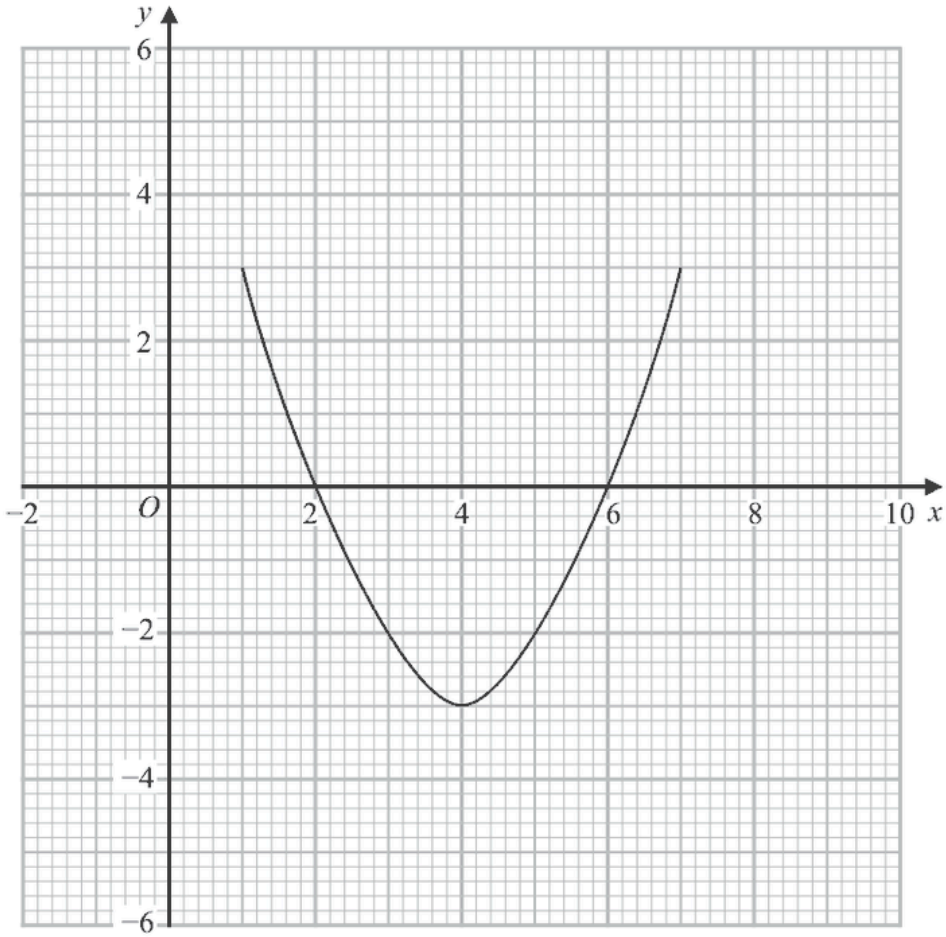
**25** The curve with equation $y = g(x)$ is transformed to the curve with equation $y = -g(x)$ by the single transformation **T**.

(a) Describe fully the transformation **T**.

.....

**(1)**

The diagram shows the graph of $y = f(x)$




(b) On the grid, draw the graph of $y = 2f(x - 1)$

**(2)**

**(Total for Question 25 is 3 marks)**

# Question 21

4 marks | Transformations of Graphs

**21** A curve has equation $y = f(x)$

The coordinates of the minimum point on this curve are $(-9, 15)$

(a) Write down the coordinates of the minimum point on the curve with equation

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

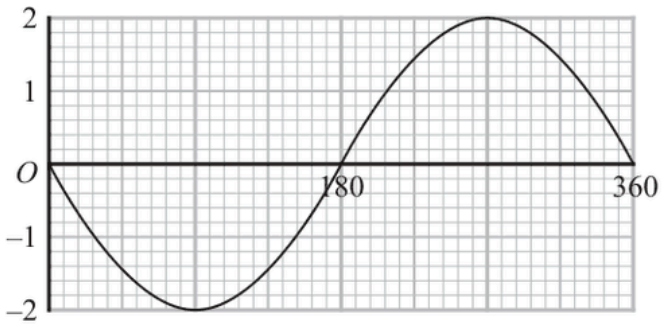
(.....  , .....)

(ii) $y = \frac{1}{3} f(x)$

(.....  , .....)

**(2)**

The graph of $y = a\cos(x + b)°$ for $0 \leqslant x \leqslant 360$ is drawn on the grid below.




Given that $a > 0$ and that $0 < b < 360$

(b) find the value of $a$ and the value of $b$.

$a =$ .....

$b =$ .....

**(2)**

**(Total for Question 21 is 4 marks)**

# Question 21

6 marks | Transformations of Graphs

**21** The curve **C** has equation $y = f(x)$ where $f(x) = 9 - 3(x + 2)^2$
The point $A$ is the maximum point on **C**.

(a) Write down the coordinates of $A$.

(.....  , .....)

(1)

The curve **C** is transformed to the curve **S** by a translation of $\begin{pmatrix} 4 \\ 0 \end{pmatrix}$

(b) Find an equation for the curve **S**.

.....

(1)

The curve **C** is transformed to the curve **T**.
The curve **T** has equation $y = 3(x + 2)^2 - 9$

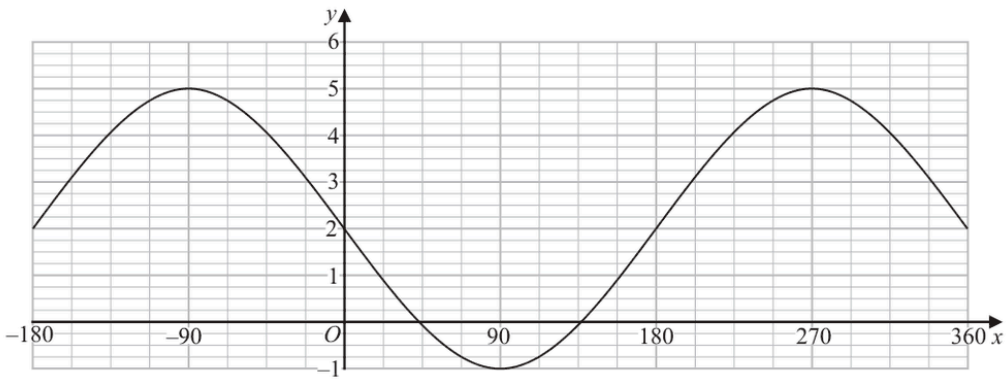
(c) Describe fully the transformation that maps curve **C** onto curve **T**.

.....

(1)

---

The graph of $y = a\cos(x - b)° + c$ for $-180 \leqslant x \leqslant 360$ is drawn on the grid below.




(d) Find the value of $a$, the value of $b$ and the value of $c$.

$a =$ .....

$b =$ .....

$c =$ .....

(3)

**(Total for Question 21 is 6 marks)**

# Question 20

6 marks | Transformations of Graphs

**20** The curve with equation $y = f(x)$ has one turning point.

The coordinates of this turning point are $(-6, -4)$

(a) Write down the coordinates of the turning point on the curve with equation

(i) $y = f(x) + 5$

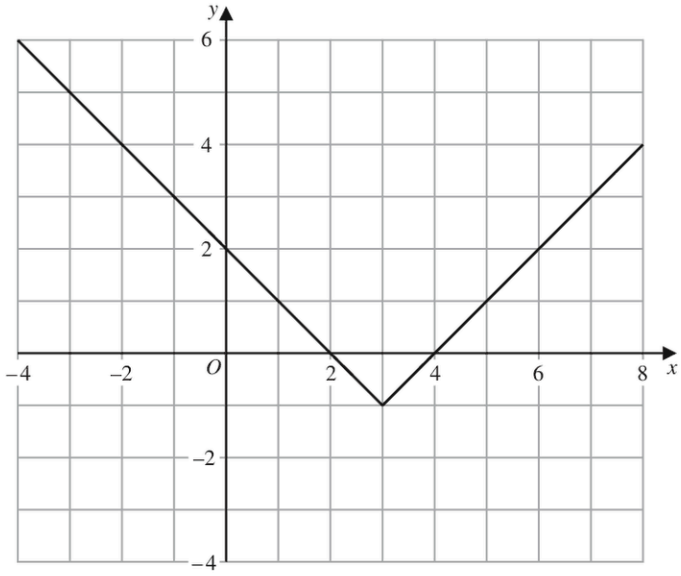
(.....)

(ii) $y = f(3x)$

(.....)

**(2)**

The graph of $y = g(x)$ is shown on the grid below.




(b) On the grid, sketch the graph of $y = 2g(x)$ for $-1 \leqslant x \leqslant 7$

**(2)**

The graph of $y = h(x)$ intersects the $x$-axis at two points.
The coordinates of the two points are $(-1, 0)$ and $(6, 0)$

The graph of $y = h(x + a)$ passes through the point with coordinates $(2, 0)$, where $a$ is a constant.

(c) Find the two possible values of $a$

....., .....

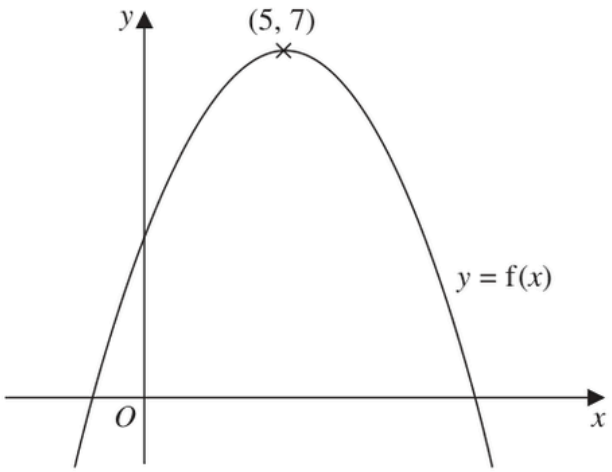
**(2)**

**(Total for Question 20 is 6 marks)**

# Question 23

2 marks | Transformations of Graphs

**23** The diagram shows a sketch of the curve with equation $y = f(x)$




There is only one maximum point on the curve.
The coordinates of this maximum point are (5, 7)

Write down the coordinates of the maximum point on the curve with equation

(i) $y = f(x + 9)$

(.....  , .....)

(ii) $y = f(x) + 3$

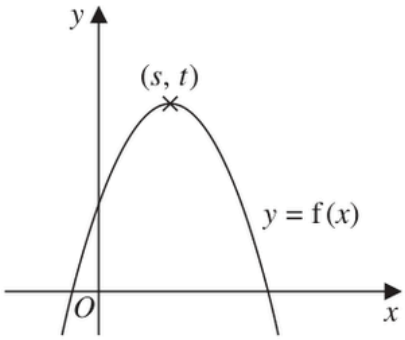
(.....  , .....)

**(Total for Question 23 is 2 marks)**

# Question 20

2 marks | Transformations of Graphs

**20** The diagram shows a sketch of part of the curve with equation $y = f(x)$




There is one maximum point on this curve.
The coordinates of this maximum point are $(s, t)$

Find, in terms of $s$ and $t$, the coordinates of the maximum point on the curve with equation

(i) $y = f(x - 2)$

(.....  , .....)

**(1)**

(ii) $y = 3f(x)$

(.....  , .....)

**(1)**

**(Total for Question 20 is 2 marks)**

# Question 22

4 marks | Transformations of Graphs

**22** The point $A$ with coordinates $(-3, 2)$ lies on the straight line with equation $y = f(x)$

(a) Find the coordinates of the image of the point $A$ on the straight line with equation

(i) $y = f(x) - 3$

(.....  , .....)

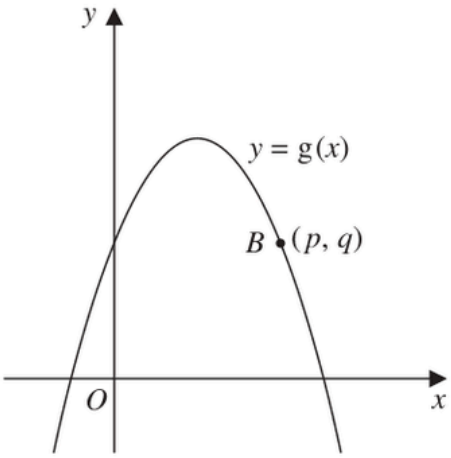
**(1)**

(ii) $y = f\left(\frac{x}{2}\right)$

(.....  , .....)

**(1)**

Here is a sketch of part of the curve with equation $y = g(x)$




The point $B$ with coordinates $(p, q)$ lies on the curve.

(b) Find the coordinates of the image of the point $B$ on the curve with equation

$$y = -g(x - c)$$

where $c$ is a constant.

(.....  , .....)

**(2)**

**(Total for Question 22 is 4 marks)**

# Question 20

7 marks | Transformations of Graphs

**20** Curve **C** has equation $y = f(x)$
The graph of curve **C** has one maximum point.
The coordinates of this maximum point are (3, 5)

(a) Write down the coordinates of the maximum point on the curve with equation

(i) $y = 2f(x)$

(.....  , .....)
**(1)**

(ii) $y = f(x) - 7$

(.....  , .....)
**(1)**

(iii) $y = f(-x)$

(.....  , .....)
**(1)**

Curve **L** has equation $y = x^2 + 7x + 20$

Curve **L** is transformed to curve **S** under the translation $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$

(b) Find an equation for **S**
Give your answer in the form $y = ax^2 + bx + c$

$y =$ .....
**(4)**

**(Total for Question 20 is 7 marks)**

# Question 21

2 marks | Transformations of Graphs

**21** A curve has equation $y = f(x)$

There is only one turning point on the curve.
The coordinates of this turning point are (6, 5)

Write down the coordinates of the turning point on the curve with equation

(a) $y = f(x - 4)$

(.....  , .....)

**(1)**

(b) $y = f(3x)$

(.....  , .....)

**(1)**

**(Total for Question 21 is 2 marks)**

# Question 24

4 marks | Transformations of Graphs

**24** The curve with equation $f(x) = 5x^2 + 9x + 2$ is transformed to the curve with equation

$g(x) = 5(x+4)^2 + 9(x+4) + 8$ by the translation $\begin{pmatrix} a \\ b \end{pmatrix}$

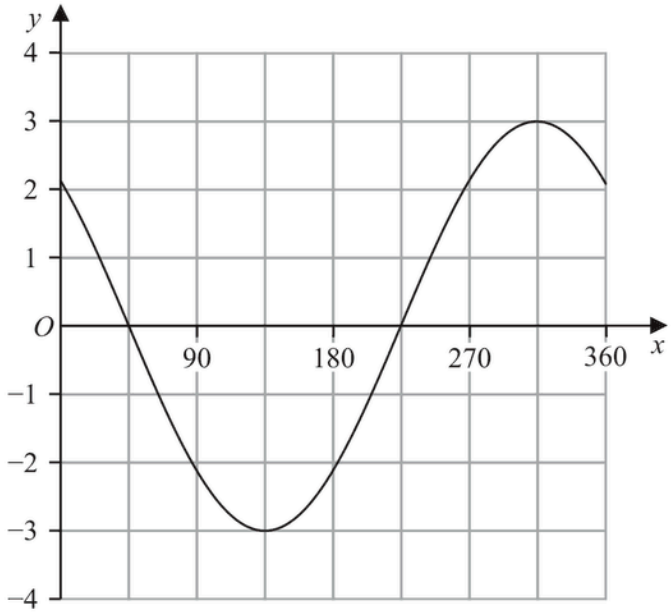
(a) Write down the value of $a$ and the value of $b$

$a =$ .....

$b =$ .....

**(2)**

The graph of $y = p\cos(x+q)^\circ$ for $0 \leqslant x \leqslant 360$ is drawn on the grid below.




Given that $p > 0$ and $0 < q < 360$

(b) find the value of $p$ and the value of $q$

$p =$ .....

$q =$ .....

**(2)**

**(Total for Question 24 is 4 marks)**

# Question 21

2 marks | Transformations of Graphs

**21** A curve has equation $y = f(x)$

There is one minimum point on this curve.
The coordinates of this minimum point are $(5, -4)$

Write down the coordinates of the minimum point on the curve with equation

(i) $y = f(x + 7)$

(.....,.....)

**(1)**

(ii) $y = f(x) - 6$

(.....,.....)

**(1)**

**(Total for Question 21 is 2 marks)**

# Question 23

2 marks | Transformations of Graphs

**23** A curve has equation $y = f(x)$
The coordinates of the minimum point on this curve are $(6, -3)$

Write down the coordinates of the minimum point on the curve with equation

(i) $y = f(x) + 10$

(.....  , .....)
**(1)**

(ii) $y = f(3x)$

(.....  , .....)
**(1)**

**(Total for Question 23 is 2 marks)**

# Question 21

3 marks | Transformations of Graphs

**21** The curve with equation $y = f(x)$ has one turning point.
The coordinates of this turning point are $(-6, 9)$

(a) Write down the coordinates of the turning point on the curve with equation $y = f(3x)$

(.....  , .....)

**(1)**

The curve **C** with equation $y = g(x)$ is transformed to give the curve **S** with equation $y = g(x + a) + b$

The point $(4, -5)$ on **C** is mapped to the point $(1, -16)$ on **S**

(b) Write down the value of $a$ and the value of $b$

$a =$ .....

$b =$ .....

**(2)**

**(Total for Question 21 is 3 marks)**

# Question 27

4 marks | Transformations of Graphs

**27** A curve has equation $y = f(x)$

There is one maximum point on this curve.
The coordinates of this maximum point are $(6, -5)$

(a) Write down the coordinates of the maximum point on the curve with equation

(i) $y = f(x - 4)$

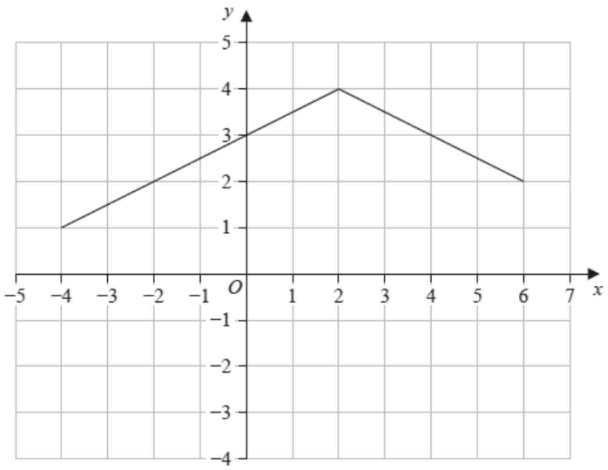
(.....)
**(1)**

(ii) $y = f(3x)$

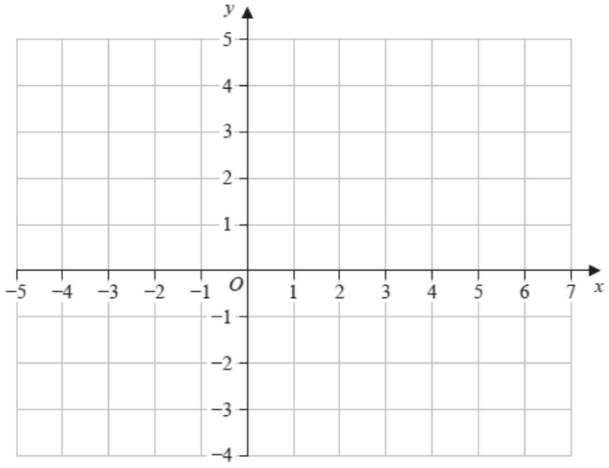
(.....)
**(1)**

P81641A
©2025 Pearson Education Ltd

Here is the graph of $y = g(x)$




(b) On the grid below, draw the graph of $y = g(2x) - 3$




**(2)**

**(Total for Question 27 is 4 marks)**

# Question 24

3 marks | Transformations of Graphs

**24** A curve has equation $y = f(x)$

There is only one turning point on the curve.
The coordinates of this turning point are (4, 3)

Write down the coordinates of the turning point on the curve with equation

(i) $y = f(x + 5)$

(.....  , .....)
**(1)**

(ii) $y = f(x) + 7$

(.....  , .....)
**(1)**

(iii) $y = f(2x)$

(.....  , .....)
**(1)**

**(Total for Question 24 is 3 marks)**

TOPIC

# Angles in Polygons & Parallel Lines

Every past-paper question on this topic, 2020 to 2026.

# Question 23

6 marks | Angles in Polygons & Parallel Lines

**23** A polygon has $n$ sides, where $n > 5$

When arranged in order of size, starting with the largest number, the sizes of the interior angles of the polygon, in degrees, are the terms of an arithmetic sequence.

Here are the first five terms of this sequence.

177 175 173 171 169

Find the value of $n$
Show clear algebraic working.

**Question 23 continued**

$n =$ .....

**(Total for Question 23 is 6 marks)**

TOPIC

# Perimeter & Area

Every past-paper question on this topic, 2020 to 2026.

# Question 22

6 marks | Perimeter & Area

**22** The diagram shows a regular octagon *ABCDEFGH*.

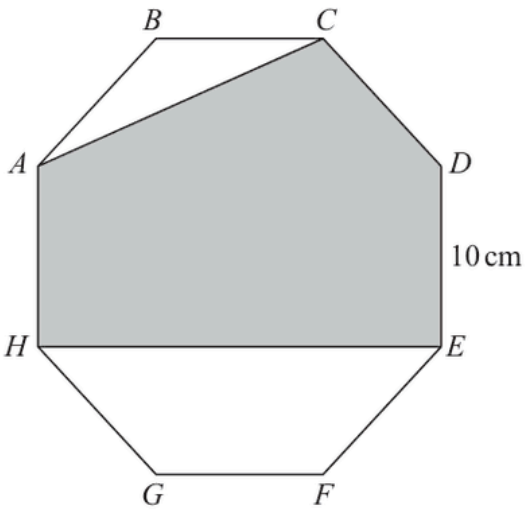



Diagram **NOT** accurately drawn

Each side of the octagon has length 10 cm.

Find the area of the shaded region *ACDEH*.
Give your answer correct to the nearest $cm^2$

..... $cm^2$

**(Total for Question 22 is 6 marks)**

# Question 20

4 marks | Perimeter & Area

**20**

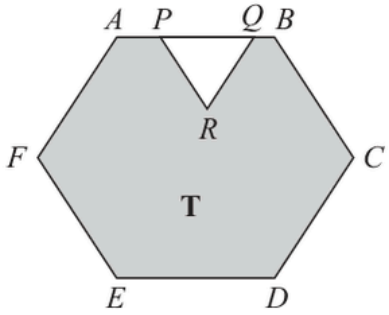



Diagram **NOT** accurately drawn

The diagram shows a shaded region **T** formed by removing an equilateral triangle $PQR$ from a regular hexagon $ABCDEF$.

The points $P$ and $Q$ lie on $AB$ such that $AB = 1.5 \times PQ$

Given that the area of region **T** is $72\sqrt{3}$ cm$^2$

work out the length of $PQ$.

..... cm

**(Total for Question 20 is 4 marks)**

# Question 21

4 marks | Perimeter & Area

**21** The diagram shows an equilateral triangle and a circle.

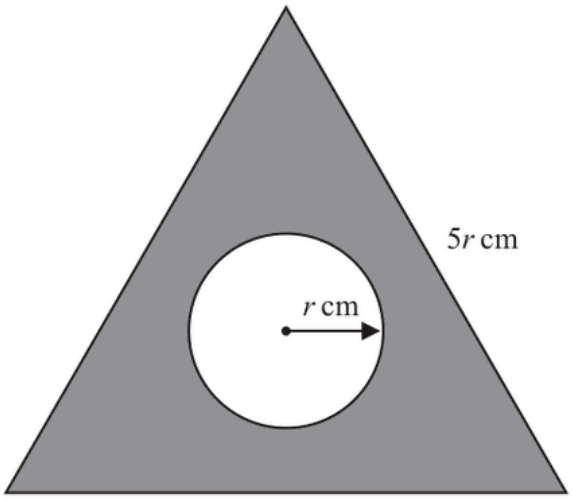



Diagram **NOT** accurately drawn

The equilateral triangle has sides of length $5r$ cm
The circle has radius $r$ cm

The area of the shaded region is $610\pi$ cm$^2$
Work out the value of $r$

Give your answer correct to 3 significant figures.

$r =$ .....

**(Total for Question 21 is 4 marks)**

TOPIC

# Circles, Arcs & Sectors

Every past-paper question on this topic, 2020 to 2026.

# Question 20

5 marks | Circles, Arcs & Sectors

**20** $A$, $B$ and $C$ are points on a circle with centre $O$.

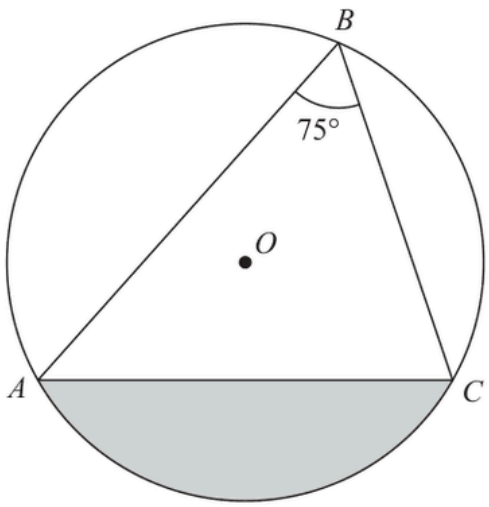



Diagram **NOT** accurately drawn

Angle $ABC = 75°$

The area of the shaded segment is $200\,\text{cm}^2$

Calculate the radius of the circle.
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 20 is 5 marks)**

# Question 22

6 marks | Circles, Arcs & Sectors

**22** The diagram shows a sector $OBC$ of a circle with centre $O$ and radius $(6 + x)$ cm.

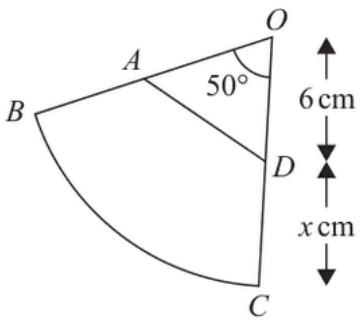



Diagram **NOT** accurately drawn

$A$ is the point on $OB$ and $D$ is the point on $OC$ such that $OA = OD = 6$ cm

Angle $BOC = 50°$

Given that

the perimeter of sector $OBC = 2 \times$ the perimeter of triangle $OAD$

find the value of $x$.
Give your answer correct to 3 significant figures.

$x =$ .....

**(Total for Question 22 is 6 marks)**

# Question 25

6 marks | Circles, Arcs & Sectors

**25** The diagram shows two circles such that the region **R**, shown shaded in the diagram, is the region common to both circles.

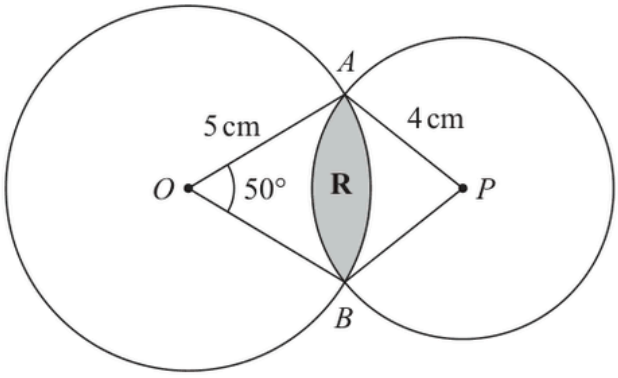



Diagram **NOT** accurately drawn

One of the circles has centre $O$ and radius 5 cm.
The other circle has centre $P$ and radius 4 cm.
Angle $AOB = 50°$

Calculate the area of region **R**.
Give your answer correct to 3 significant figures.

..... $cm^2$

**(Total for Question 25 is 6 marks)**

# Question 20

4 marks | Circles, Arcs & Sectors

**20** The diagram shows four identical circles drawn inside a square.

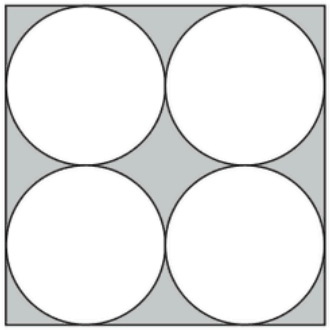


Diagram **NOT** accurately drawn

Each circle touches two other circles and two sides of the square.

The region inside the square that is outside the circles, shown shaded in the diagram, has a total area of $40\,cm^2$

Work out the perimeter of the square.
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 20 is 4 marks)**

# Question 22

6 marks | Circles, Arcs & Sectors

**22** The diagram shows two circles with centre $O$ and a regular pentagon $ABCDE$

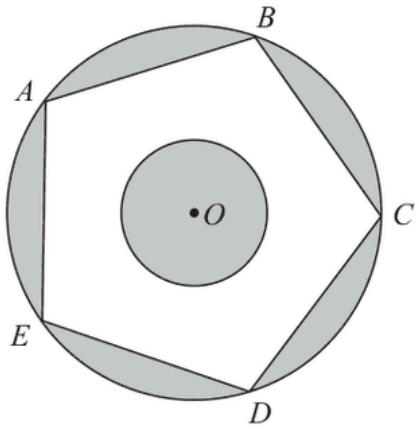



Diagram **NOT** accurately drawn

$A$, $B$, $C$, $D$ and $E$ are points on the larger circle.
The pentagon has sides of length 8 cm.

The diagram is shaded such that

shaded area = unshaded area

Work out the radius of the smaller circle.
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 22 is 6 marks)**

# Question 20

4 marks | Circles, Arcs & Sectors

**20** The diagram shows equilateral triangle $ABC$ with sides of length 10 cm.
A circle is drawn inside the triangle.

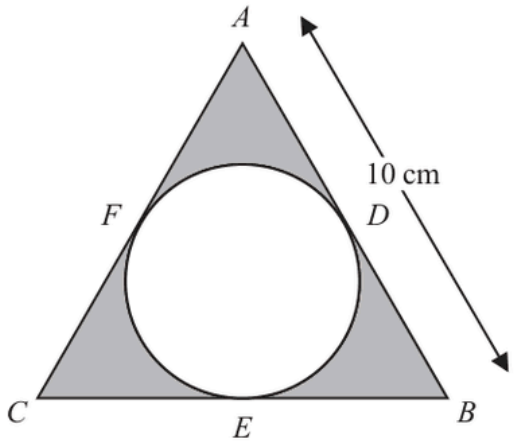



Diagram **NOT** accurately drawn

$D$, $E$ and $F$ are points on the circle.

$ADB$, $BEC$ and $CFA$ are tangents to the circle.

Calculate the total area of the regions shown shaded in the diagram.
Give your answer correct to 3 significant figures.

..... $cm^2$

**(Total for Question 20 is 4 marks)**

# Question 20

4 marks | Circles, Arcs & Sectors

**20** The diagram shows a sector $OABC$ of a circle centre $O$

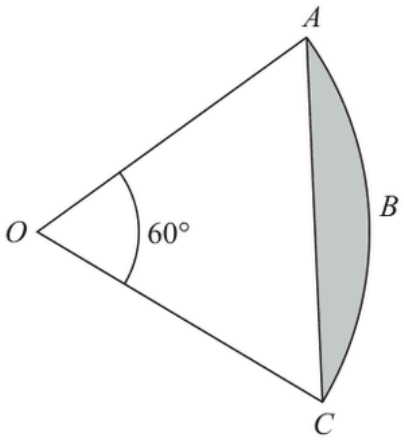



Diagram **NOT** accurately drawn

Angle $AOC = 60°$

The area of the shaded segment $ABC$ is $38\,cm^2$

Work out the perimeter of the shaded segment $ABC$
Give your answer correct to one decimal place.

..... cm

**(Total for Question 20 is 4 marks)**

# Question 21

5 marks | Circles, Arcs & Sectors

**21** The diagram shows a square $ABCD$ and a circle.

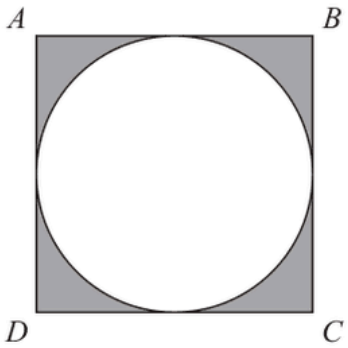



Diagram **NOT** accurately drawn

The sides of the square are tangents to the circle.

The total area of the shaded regions is $80\,\text{cm}^2$

Work out the length of $AC$
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 21 is 5 marks)**

# Question 25

5 marks | Circles, Arcs & Sectors

**25** The diagram shows an equilateral triangle $ABC$ and a circle with centre $O$

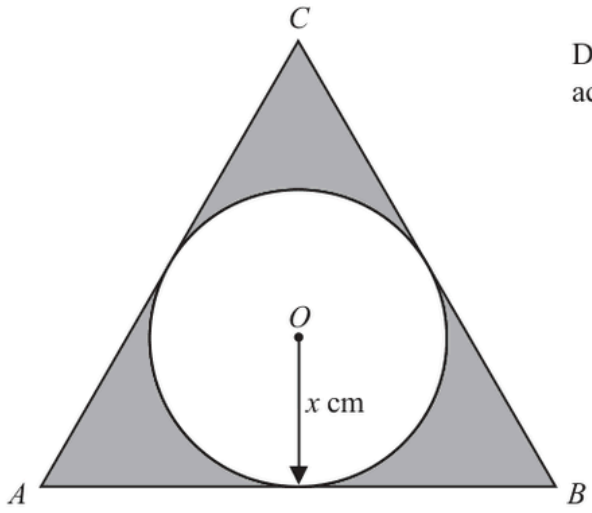



Diagram **NOT** accurately drawn

$AB$, $BC$ and $CA$ are tangents to the circle.

The radius of the circle is $x$ cm

The total area, in cm$^2$, of the regions shown shaded in the diagram is $nx^2$

Find the value of $n$
Give your answer correct to 3 significant figures.

$n =$ .....

**(Total for Question 25 is 5 marks)**

# Question 22

6 marks | Circles, Arcs & Sectors

**22**

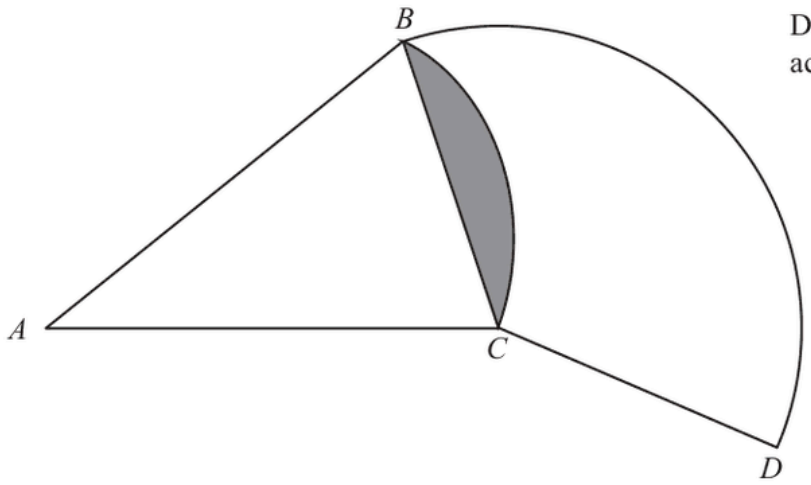



Diagram **NOT** accurately drawn

*BAC* is a sector of a circle, centre *A*

*BCD* is a sector of a circle, centre *C*

Angle *BAC* = 40°
Angle *BCD* = 130°
Area of shaded segment = 28 cm$^2$

Find the length of the arc *BD*
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 22 is 6 marks)**

# Question 25

6 marks | Circles, Arcs & Sectors

**25**

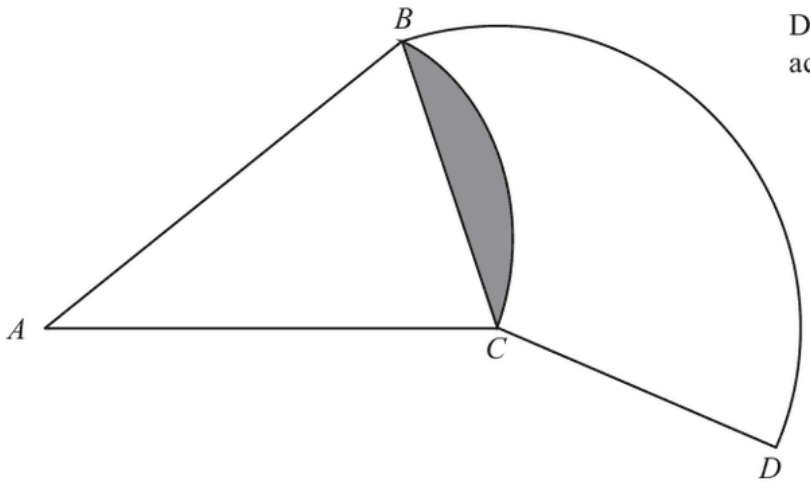



Diagram **NOT** accurately drawn

*BAC* is a sector of a circle, centre *A*

*BCD* is a sector of a circle, centre *C*

Angle *BAC* = 40°
Angle *BCD* = 130°
Area of shaded segment = 28 cm$^2$

Find the length of the arc *BD*
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 25 is 6 marks)**

# Question 23

6 marks | Circles, Arcs & Sectors

**23** $OPQ$ and $OAB$ are sectors of a circle, centre $O$

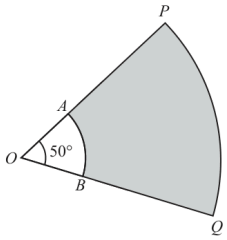



Diagram **NOT** accurately drawn

Angle $POQ = 50°$

$A$ is the point on $OP$ such that $OA = \frac{1}{4}OP$

The area of the shaded region is $\frac{243}{16}\pi\ \text{cm}^2$

Work out the perimeter of the shaded region.
Give your answer in the form $a\pi + b$ where $a$ and $b$ are constants.
Show your working clearly.

.....cm

**(Total for Question 23 is 6 marks)**

TOPIC

# Volume & Surface Area

Every past-paper question on this topic, 2020 to 2026.

# Question 22

5 marks | Volume & Surface Area

**22** A solid is made from a cone and a hemisphere.

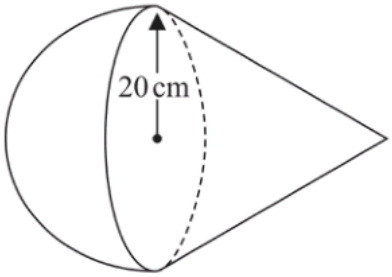



Diagram **NOT** accurately drawn

The circular plane face of the hemisphere coincides with the circular base of the cone.
The radius of the hemisphere and the radius of the circular base of the cone are both 20 cm

The curved surface area of the cone is $580\pi\,\text{cm}^2$

The volume of the solid is $k\pi\,\text{cm}^3$

Work out the exact value of $k$

$k =$ .....

**(Total for Question 22 is 5 marks)**

# Question 26

6 marks | Volume & Surface Area

**26** Here is a sector, $AOB$, of a circle with centre $O$ and angle $AOB = x°$

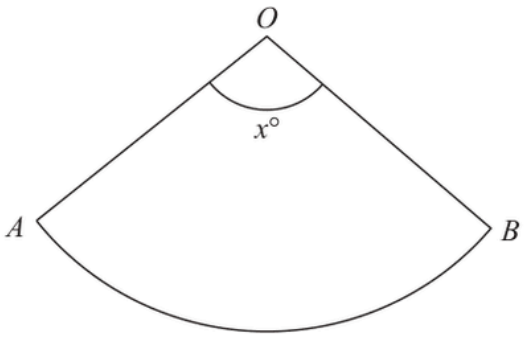



Diagram **NOT** accurately drawn

The sector can form the curved surface of a cone by joining $OA$ to $OB$.

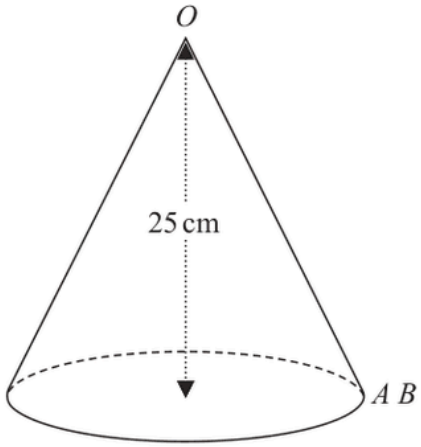



Diagram **NOT** accurately drawn

The height of the cone is 25 cm.
The volume of the cone is 1600 $cm^3$

Work out the value of $x$.
Give your answer correct to the nearest whole number.

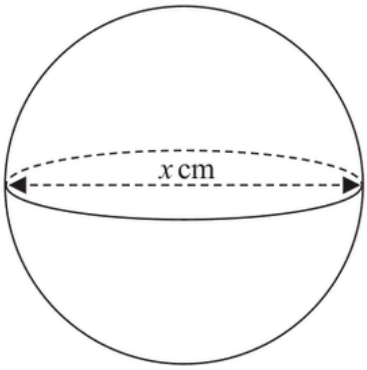
$x =$ .....

**(Total for Question 26 is 6 marks)**

# Question 22

6 marks | Volume & Surface Area

**22** The diagram shows a sphere of diameter $x$ cm and a pyramid $ABCDE$ with a horizontal rectangular base $BCDE$.



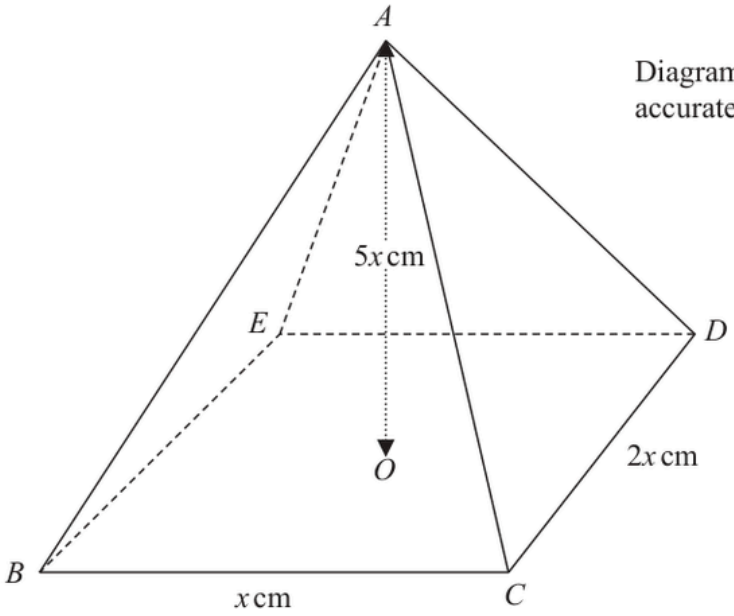




Diagram **NOT** accurately drawn

The vertex $A$ of the pyramid is vertically above the centre $O$ of the base so that $AB = AC = AD = AE$.

$BC = x$ cm, $CD = 2x$ cm and $AO = 5x$ cm.

The volume of the sphere is $288\pi$ cm$^3$

Calculate the total surface area of the pyramid.
Give your answer correct to the nearest cm$^2$

..... cm$^2$

**(Total for Question 22 is 6 marks)**

# Question 22

5 marks | Volume & Surface Area

**22** A solid is made from a cone and a hemisphere.

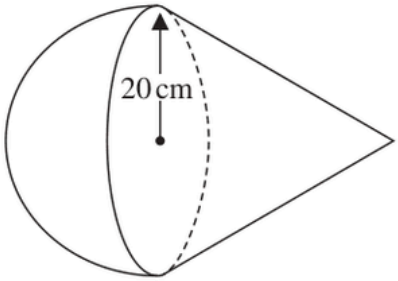



Diagram **NOT** accurately drawn

The circular plane face of the hemisphere coincides with the circular base of the cone.
The radius of the hemisphere and the radius of the circular base of the cone are both 20 cm.

The curved surface area of the cone is $580\pi \text{ cm}^2$

The volume of the solid is $k\pi \text{ cm}^3$

Work out the exact value of $k$

$k =$ .....

**(Total for Question 22 is 5 marks)**

# Question 24

5 marks | Volume & Surface Area

**24** The surface area of sphere **A** is nine times the surface area of sphere **B**
The difference between the volume of sphere **A** and the volume of sphere **B** is $117\pi$ cm$^3$

Find the radius of the smaller sphere.
Show your working clearly.

..... cm

**(Total for Question 24 is 5 marks)**

# Question 21

5 marks | Volume & Surface Area

**21** Here is a triangular prism $ABCDEF$

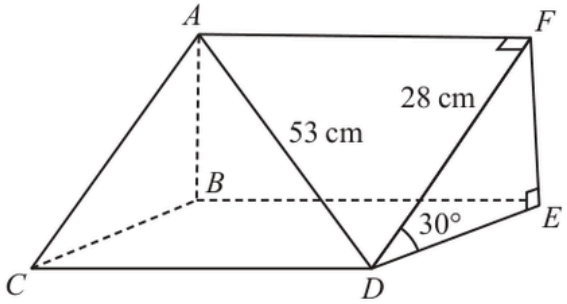



Diagram **NOT** accurately drawn

$AD = 53$ cm
$DF = 28$ cm
Angle $FDE = 30°$

Work out the volume of the triangular prism.
Give your answer correct to the nearest whole number.

..... $cm^3$

**(Total for Question 21 is 5 marks)**

# Question 23

5 marks | Volume & Surface Area

**23** A solid shape is made by removing a hemisphere, shown shaded, from a cone as shown in the diagram.

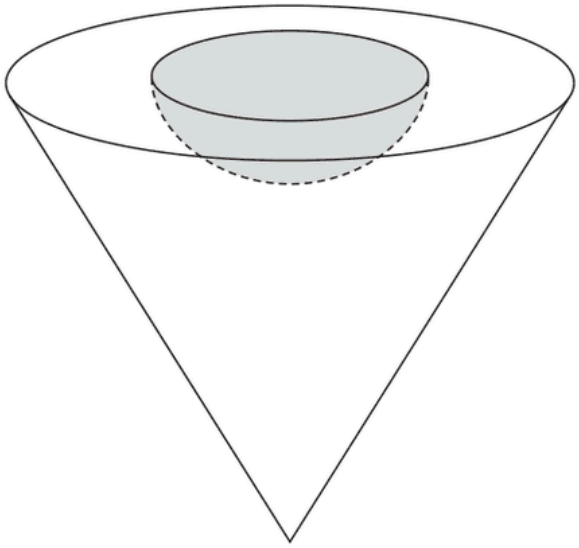


Diagram **NOT** accurately drawn

The radius of the hemisphere is $2x$ cm
The radius of the base of the cone is $5x$ cm
The vertical height of the cone is $6x$ cm

The volume of the solid shape is $6948\pi$ cm$^3$

Work out the **total** surface area of the solid hemisphere that has been removed from the cone.
Give your answer correct to the nearest integer.

..... cm$^2$

**(Total for Question 23 is 5 marks)**

# Question 22

3 marks | Volume & Surface Area

**22** The diagram shows a bowl in the shape of a hemisphere.
The bowl is made from metal.

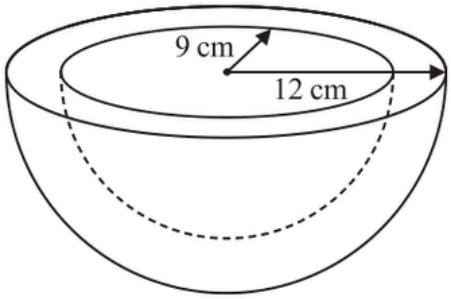



Diagram **NOT** accurately drawn

The outer radius of the bowl is 12 cm
The inner radius of the bowl is 9 cm

The thickness of the bowl is uniform.

Work out the volume of the metal.
Give your answer correct to the nearest whole number.

..... $cm^3$

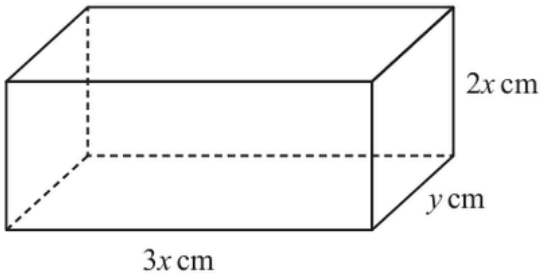
**(Total for Question 22 is 3 marks)**

# Question 21

3 marks | Volume & Surface Area

**21** The diagram shows a cuboid.

Diagram **NOT** accurately drawn




The cuboid measures $3x$ cm by $2x$ cm by $y$ cm

The volume of the cuboid is $1014\,\text{cm}^3$
The total surface area of the cuboid is $A\,\text{cm}^2$

Show that $A = 12x^2 + \frac{1690}{x}$

You must show all the stages of your working.

**(Total for Question 21 is 3 marks)**

# Question 21

5 marks | Volume & Surface Area

**21** The diagram shows a solid cuboid.

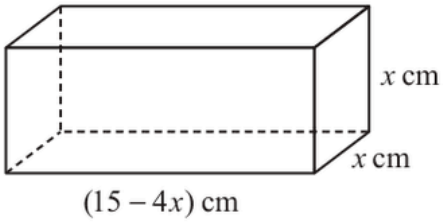



Diagram **NOT** accurately drawn

The volume of the cuboid is $V$ cm$^3$

Find the maximum value of $V$

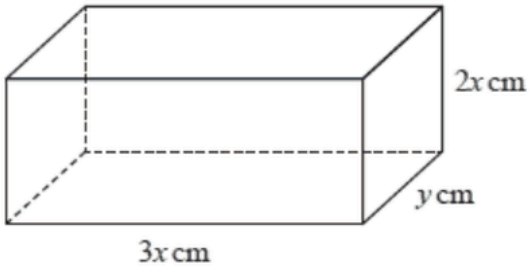
**(Total for Question 21 is 5 marks)**

# Question 23

3 marks | Volume & Surface Area

**23** The diagram shows a cuboid.

Diagram **NOT** accurately drawn




The cuboid measures $3x$ cm by $2x$ cm by $y$ cm

The volume of the cuboid is 1014 cm$^3$
The total surface area of the cuboid is $A$ cm$^2$

Show that $A = 12x^2 + \frac{1690}{x}$

You must show all the stages of your working.

**(Total for Question 23 is 3 marks)**

# Question 25

5 marks | Volume & Surface Area

**25** The diagram shows a solid hemisphere, $H$

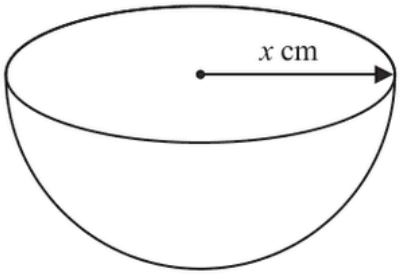



Diagram **NOT** accurately drawn

The radius of $H$ is $x$ cm
The volume of $H$ is $6174\pi$ cm$^3$

A bowl is made by removing a solid hemisphere from $H$ such that the uniform thickness of the bowl is 2 cm

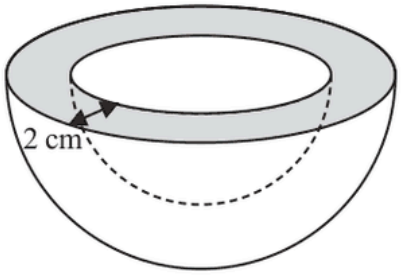



Diagram **NOT** accurately drawn

Work out the **total** surface area of the bowl.
Give your answer in terms of $\pi$

..... cm$^2$

**(Total for Question 25 is 5 marks)**

# Question 26

5 marks | Volume & Surface Area

**26** The diagram shows a solid hemisphere, $H$

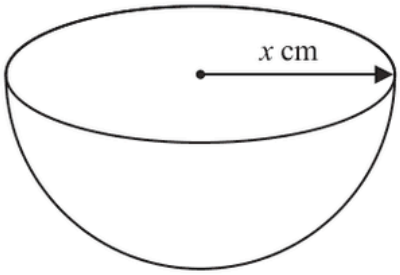



Diagram **NOT** accurately drawn

The radius of $H$ is $x$ cm
The volume of $H$ is $6174\pi$ cm$^3$

A bowl is made by removing a solid hemisphere from $H$ such that the uniform thickness of the bowl is 2 cm

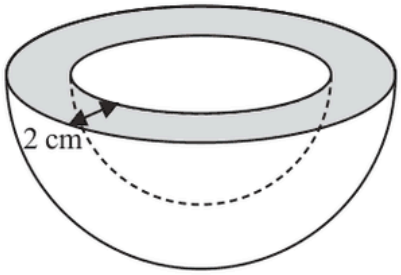



Diagram **NOT** accurately drawn

Work out the **total** surface area of the bowl.
Give your answer in terms of $\pi$

..... cm$^2$

**(Total for Question 26 is 5 marks)**

# Question 20

5 marks | Volume & Surface Area

**20** The diagram shows a solid shape.

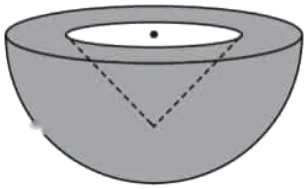


Diagram **NOT** accurately drawn

The solid shape is made by removing a cone from a hemisphere.

The radius of the cone is $x$ cm
The height of the cone is $x$ cm

The radius of the hemisphere is $2x$ cm

The volume of the solid shape is $\frac{3645}{8}\pi$ cm$^3$

Find the outer curved surface area of the solid shape.
Give your answer correct to the nearest whole number.

..... cm$^2$

**(Total for Question 20 is 5 marks)**

TOPIC

# 3D Pythagoras & Trigonometry

Every past-paper question on this topic, 2020 to 2026.

# Question 22

4 marks | 3D Pythagoras & Trigonometry

**22** $ABC$ is an isosceles triangle in a horizontal plane.
The point $T$ is vertically above $B$.

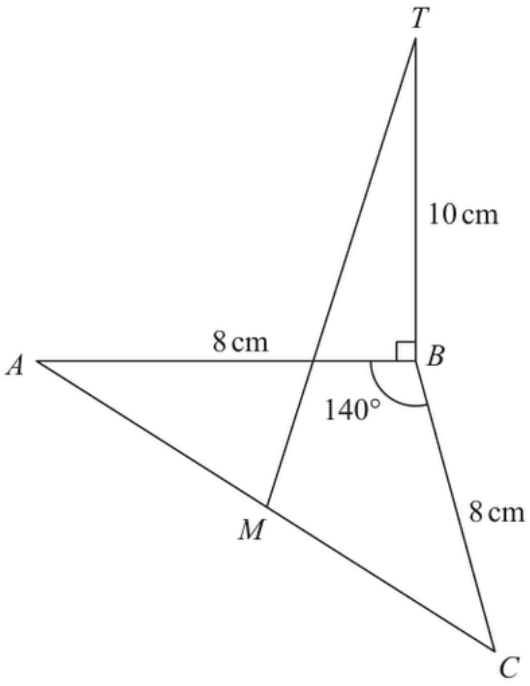



Diagram **NOT** accurately drawn

Angle $ABC = 140°$
$AB = BC = 8$ cm
$TB = 10$ cm
$M$ is the midpoint of $AC$.

Calculate the size of the angle between $MT$ and the horizontal plane $ABC$.
Give your answer correct to one decimal place.

.....°

**(Total for Question 22 is 4 marks)**

# Question 22

4 marks | 3D Pythagoras & Trigonometry

**22** The diagram shows a triangular prism $ABCDEF$ with a horizontal base $ABEF$.

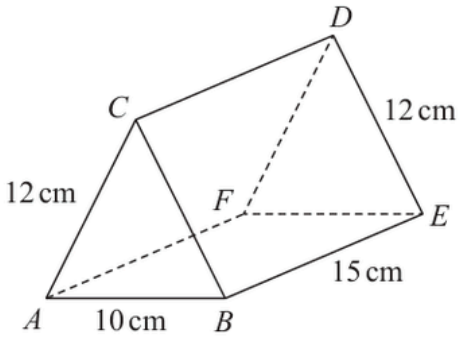



Diagram **NOT** accurately drawn

$AC = BC = FD = ED = 12\,\text{cm}$ $AB = 10\,\text{cm}$ $BE = 15\,\text{cm}$

Calculate the size of the angle between $AD$ and the base $ABEF$.
Give your answer correct to 3 significant figures.

.....°

**(Total for Question 22 is 4 marks)**

# Question 21

5 marks | 3D Pythagoras & Trigonometry

**21** The diagram shows the prism $ABCDEFGHJK$ with horizontal base $AEFG$

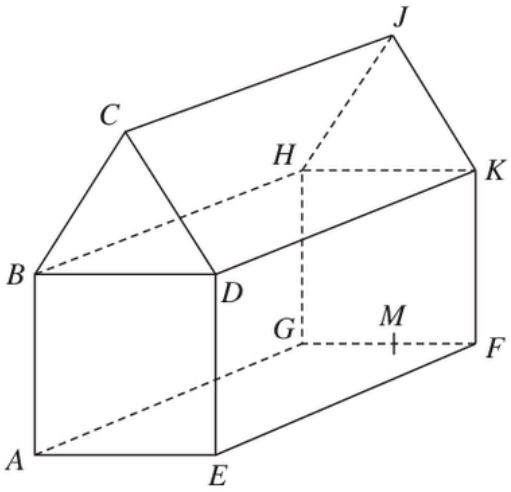



Diagram **NOT** accurately drawn

$ABCDE$ is a cross section of the prism where
$ABDE$ is a square
$BCD$ is an equilateral triangle

$EF = 2 \times AE$
$M$ is the midpoint of $GF$ so that $JM$ is vertical.

Angle $MAJ = y°$

Given that $\tan y° = T$

find the value of $T$, giving your answer in the form $\frac{\sqrt{p} + \sqrt{q}}{17}$ where $p$ and $q$ are integers.

$T =$ .....

**(Total for Question 21 is 5 marks)**

# Question 22

5 marks | 3D Pythagoras & Trigonometry

**22** Here is a cuboid $ABCDEFGH$

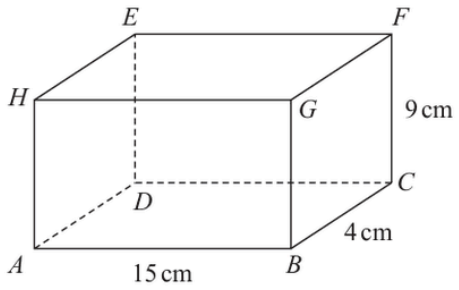



Diagram **NOT** accurately drawn

$AB = 15\,\text{cm}$ $BC = 4\,\text{cm}$ $CF = 9\,\text{cm}$

(a) Work out the length of $BE$
Give your answer correct to 3 significant figures.

..... cm

**(2)**

Here is a cuboid $PQRSTUVW$

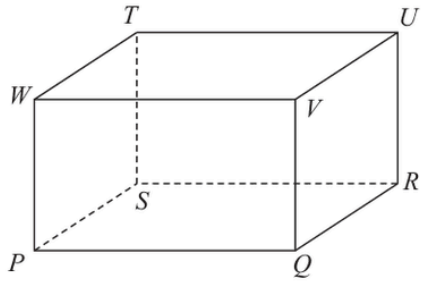



Diagram **NOT** accurately drawn

$PR = 42\,\text{cm}$

The size of the angle between $PU$ and the plane $PQRS$ is 30°

$M$ is the midpoint of $PR$

(b) Work out the size of angle $UMR$
Give your answer correct to 3 significant figures.

.....°

**(3)**

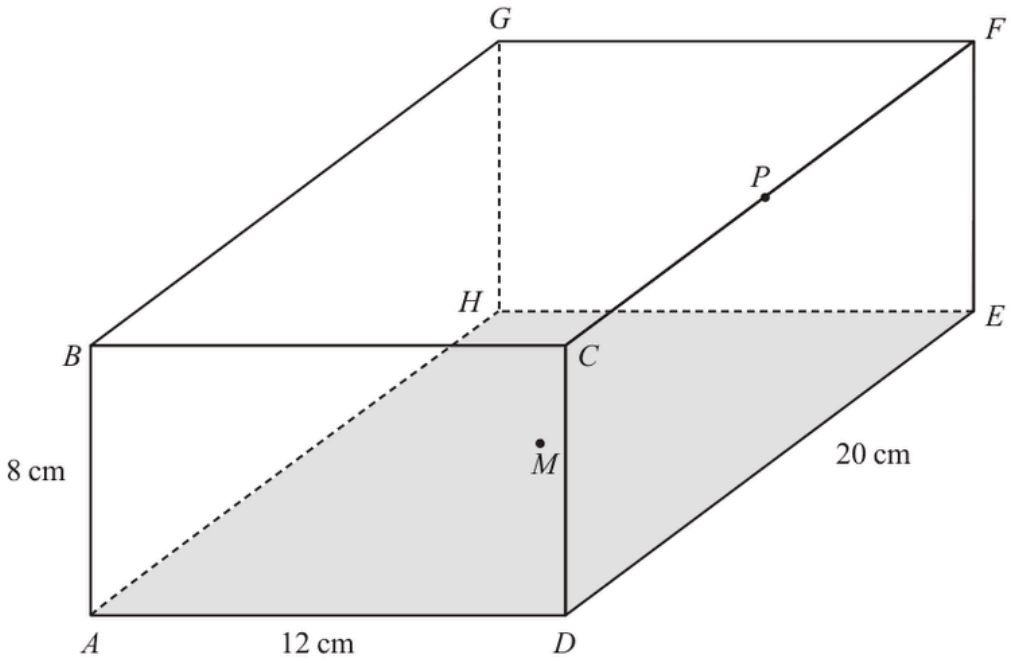
**(Total for Question 22 is 5 marks)**

# Question 22

6 marks | 3D Pythagoras & Trigonometry

**22** The diagram shows a cuboid $ABCDEFGH$ with horizontal base $ADEH$

Diagram **NOT** accurately drawn




$AB = 8$ cm $\quad AD = 12$ cm $\quad DE = 20$ cm

$M$ is the midpoint of the base $ADEH$ and $P$ is the midpoint of the edge $CF$

Work out the size of angle $BMP$
Give your answer correct to one decimal place.

.....°

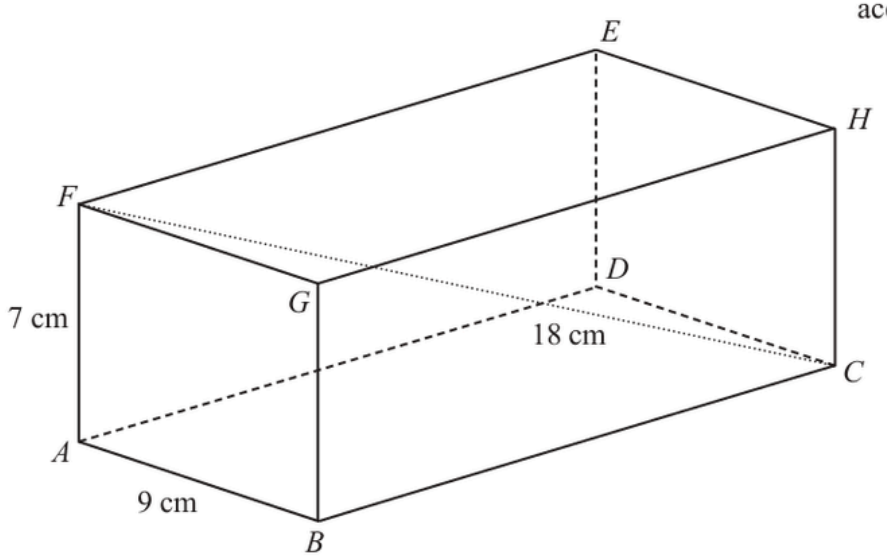
**(Total for Question 22 is 6 marks)**

# Question 20

3 marks | 3D Pythagoras & Trigonometry

**20** The diagram shows cuboid $ABCDEFGH$

Diagram **NOT** accurately drawn




$AB = 9\,\text{cm}$ $AF = 7\,\text{cm}$ $FC = 18\,\text{cm}$

Calculate the length of $BC$
Give your answer correct to 3 significant figures.

..... cm

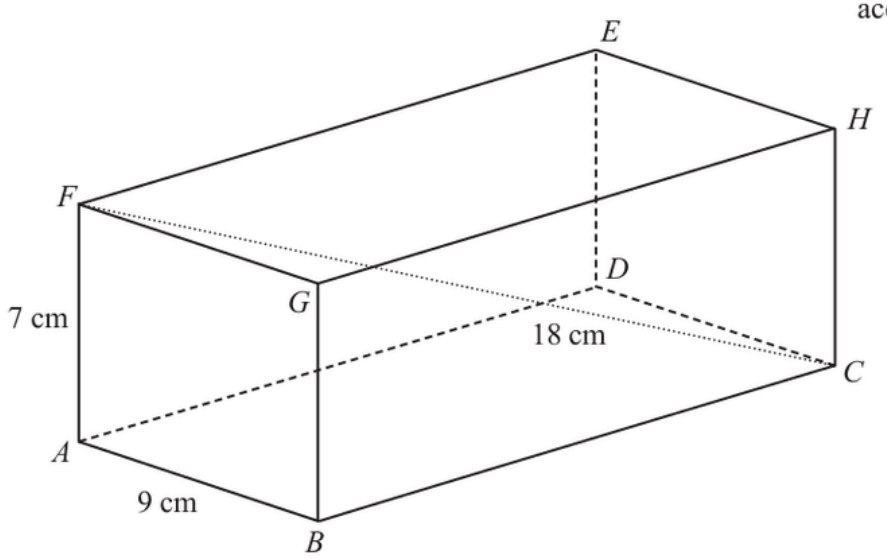
**(Total for Question 20 is 3 marks)**

# Question 20

3 marks | 3D Pythagoras & Trigonometry

**20** The diagram shows cuboid $ABCDEFGH$

Diagram **NOT** accurately drawn




$AB = 9\,\text{cm}$ $AF = 7\,\text{cm}$ $FC = 18\,\text{cm}$

Calculate the length of $BC$
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 20 is 3 marks)**

# Question 23

3 marks | 3D Pythagoras & Trigonometry

**23** The diagram shows a triangular prism, $ABCDEF$, with a horizontal rectangular base $ABCD$

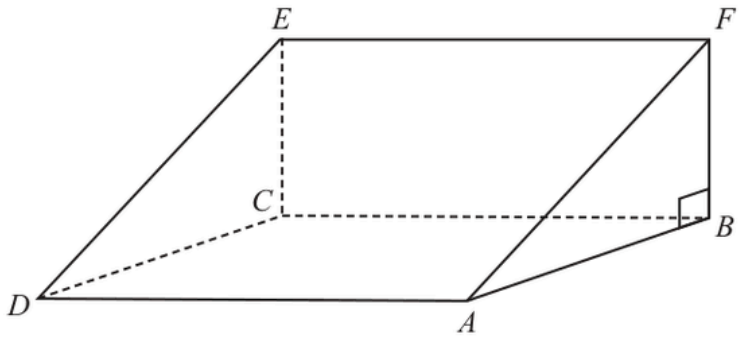



Diagram **NOT** accurately drawn

$M$ is the midpoint of the line $AC$

$AC = 40\,\text{cm}$ angle $CAE = 35°$ angle $ABF = 90°$

Work out the size of angle $CME$
Give your answer correct to 3 significant figures.

.....°

**(Total for Question 23 is 3 marks)**

# Question 23

6 marks | 3D Pythagoras & Trigonometry

**23** The diagram shows cuboid $ABCDEFGH$

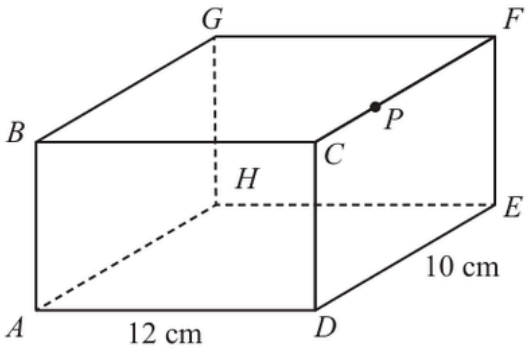



Diagram **NOT** accurately drawn

The point $P$ lies on $CF$

$AD = 12$ cm $\quad DE = 10$ cm $\quad CP = 3$ cm

The angle of elevation of $P$ from $A$ is $24°$

Calculate the size of angle $APG$
Give your answer correct to the nearest degree.
Show your working clearly.

.....°

**(Total for Question 23 is 6 marks)**

# Question 24

4 marks | 3D Pythagoras & Trigonometry

**24** The diagram shows a square-based pyramid $ABCDE$

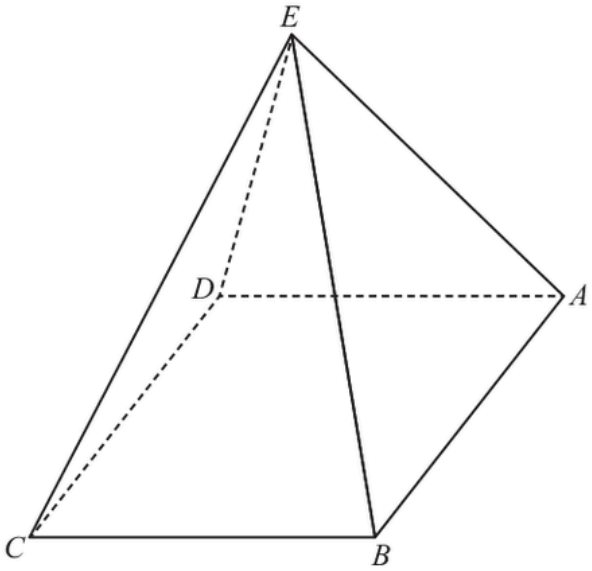



Diagram **NOT** accurately drawn

$EA = EB = EC = ED$

$M$ is the centre of the horizontal square base $ABCD$
$Q$ is the midpoint of $AB$
Angle $EQM = 80°$

$EA : AB = n : 1$

Find the value of $n$
Give your answer correct to 3 significant figures.

$n =$ .....

**(Total for Question 24 is 4 marks)**

# Question 26

5 marks | 3D Pythagoras & Trigonometry

**26** The diagram shows prism $ABCDEFGH$

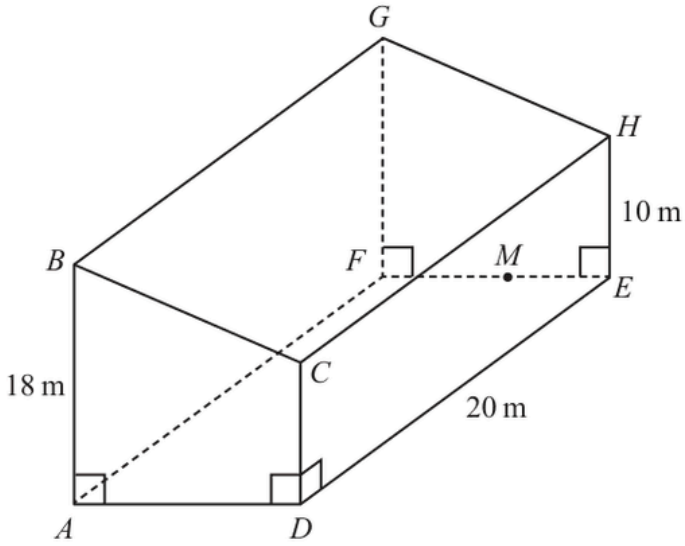



Diagram **NOT** accurately drawn

$$AB = FG = 18\,\text{m} \qquad DC = EH = 10\,\text{m} \qquad AD = FE$$
$$DE = CH = AF = BG = 20\,\text{m}$$
$$\text{angle } BAD = \text{angle } ADC = \text{angle } CDE = 90°$$

$M$ is the point on $FE$ such that $FM = \frac{3}{5}FE$

Given that angle $GMF = 60°$

calculate the angle of elevation of $G$ from $D$
Give your answer correct to one decimal place.
Show your working clearly.

.....°

**(Total for Question 26 is 5 marks)**

# Question 26

5 marks | 3D Pythagoras & Trigonometry

**26** Here is a prism $ABCDEFGH$ with a horizontal, rectangular base $ABGF$

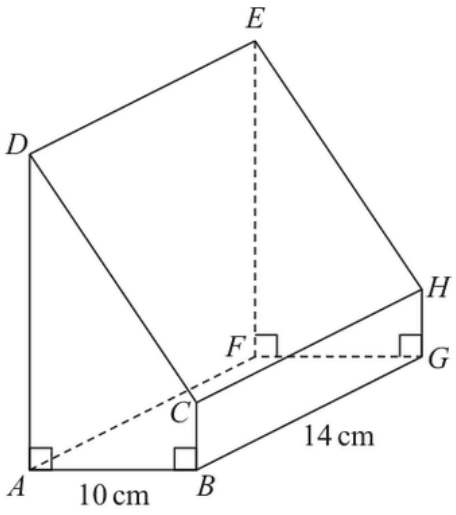



Diagram **NOT** accurately drawn

$AB = 10\,\text{cm}$ $BG = 14\,\text{cm}$

angle $DAB$ = angle $ABC$ = angle $EFG$ = angle $FGH = 90°$

$BC = \frac{1}{5}AD$

The angle of elevation of $E$ from $B$ is $50°$

Calculate the volume of the prism.
Give your answer correct to 3 significant figures.
Show your working clearly.

..... $\text{cm}^3$

**(Total for Question 26 is 5 marks)**

TOPIC

# Sine & Cosine Rules

Every past-paper question on this topic, 2020 to 2026.

# Question 21

6 marks | Sine & Cosine Rules

**21** The diagram shows the prism $ABCDEF$ with cross section triangle $ABC$.

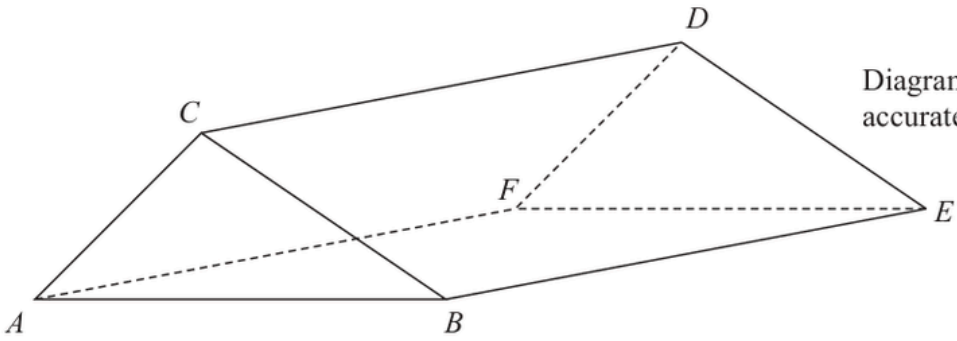



Diagram **NOT** accurately drawn

Angle $BEC = 40°$ and angle $ACB$ is obtuse.
$AC = 6\,\text{cm}$ and $CE = 13\,\text{cm}$

The area of triangle $ABC$ is $22\,\text{cm}^2$

Calculate the length of $AB$.
Give your answer correct to one decimal place.

..... cm

**(Total for Question 21 is 6 marks)**

# Question 23

6 marks | Sine & Cosine Rules

**23** The diagram shows triangle $PQR$

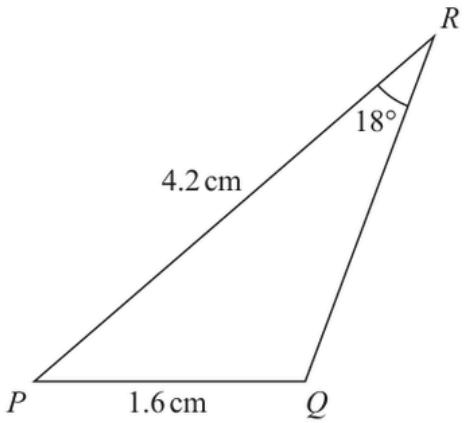



Diagram **NOT** accurately drawn

$PQ = 1.6\,\text{cm}$ $PR = 4.2\,\text{cm}$ Angle $PRQ = 18°$

Given that angle $PQR$ is obtuse,

work out the area of triangle $PQR$
Give your answer correct to 3 significant figures.

..... $\text{cm}^2$

**(Total for Question 23 is 6 marks)**

# Question 22

5 marks | Sine & Cosine Rules

**22** The diagram shows a triangle $ABC$ and a flagpole $BF$

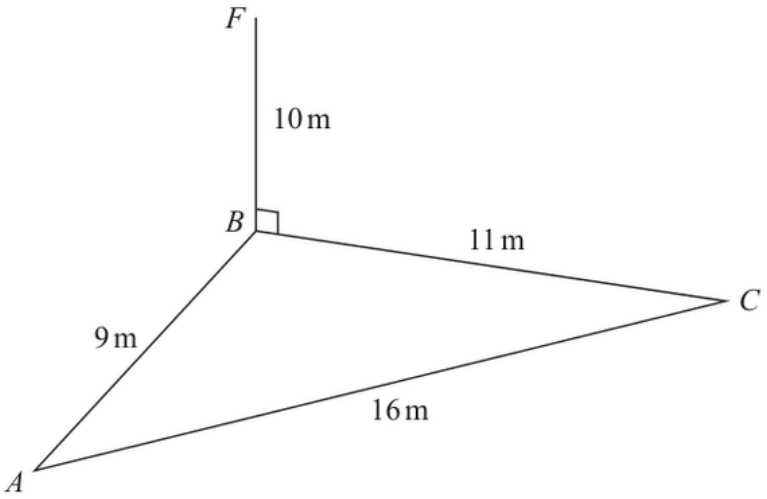



Diagram **NOT** accurately drawn

$A$, $B$ and $C$ are points on horizontal ground.

$BF$ is vertical.

$AB = 9\,\text{m}$ $BC = 11\,\text{m}$ $AC = 16\,\text{m}$ $BF = 10\,\text{m}$

$D$ is the point on $AC$ such that angle $BDC = 90°$

Work out the size of the angle of elevation of the point $F$ from the point $D$
Give your answer correct to one decimal place.

.....°

**(Total for Question 22 is 5 marks)**

# Question 25

6 marks | Sine & Cosine Rules

**25** Here is a triangle $ABC$

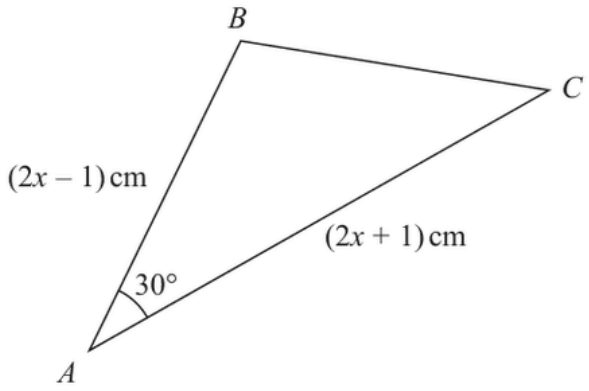



Diagram **NOT** accurately drawn

The area of the triangle is $(x^2 + x - 3.75)\,\text{cm}^2$

Find the size of the largest angle in triangle $ABC$
Give your answer correct to the nearest degree.

.....°

**(Total for Question 25 is 6 marks)**

# Question 20

5 marks | Sine & Cosine Rules

**20**

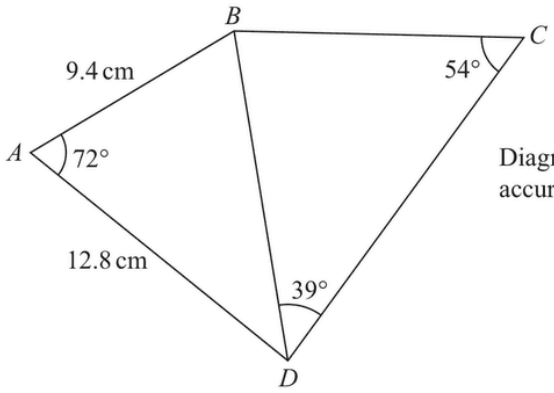



Diagram **NOT** accurately drawn

Work out the length of $BC$
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 20 is 5 marks)**

# Question 21

5 marks | Sine & Cosine Rules

**21**

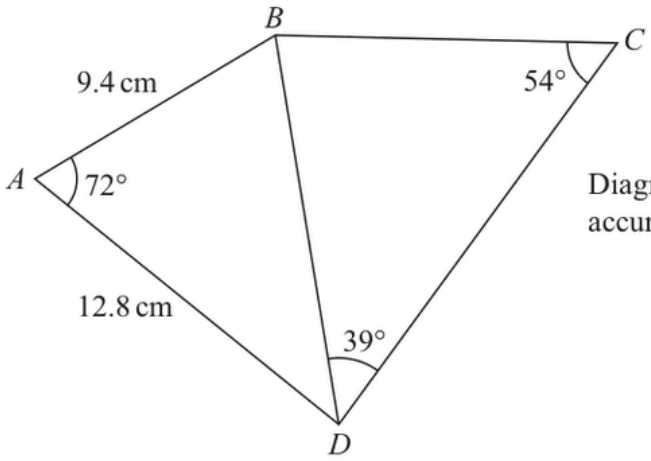



Diagram **NOT** accurately drawn

Work out the length of $BC$
Give your answer correct to 3 significant figures.

..... cm

**(Total for Question 21 is 5 marks)**



TOPIC

# Area & Volume of Similar Shapes

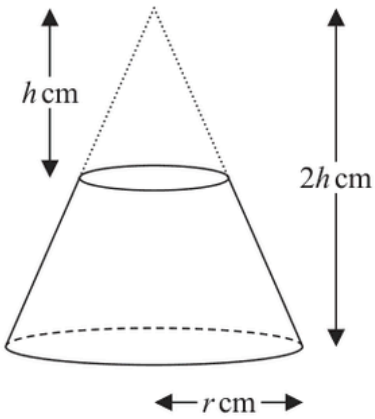
Every past-paper question on this topic, 2020 to 2026.

# Question 20

5 marks | Area & Volume of Similar Shapes

**20** The diagram shows a frustum of a cone and a sphere.

The frustum is made by removing a small cone from a large cone.
The cones are similar.



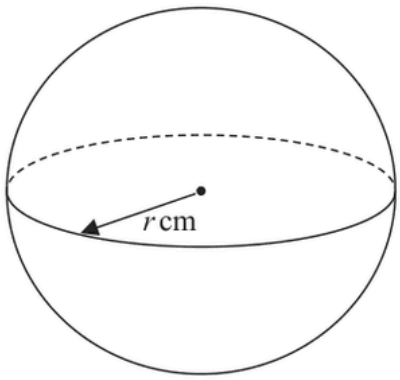




Diagram **NOT** accurately drawn

The height of the small cone is $h$ cm.
The height of the large cone is $2h$ cm.
The radius of the base of the large cone is $r$ cm.

The radius of the sphere is $r$ cm.

Given that the volume of the frustum is equal to the volume of the sphere,

find an expression for $r$ in terms of $h$.
Give your expression in its simplest form.

$r =$ .....

**(Total for Question 20 is 5 marks)**

# Question 20

4 marks | Area & Volume of Similar Shapes

**20** The diagram shows two similar vases, **A** and **B**.

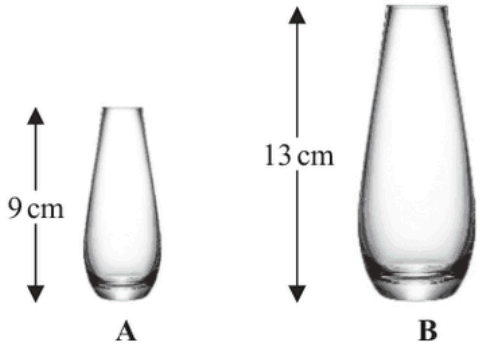



Diagram **NOT** accurately drawn

The height of vase **A** is 9 cm and the height of vase **B** is 13 cm.

Given that

surface area of vase **A** + surface area of vase **B** = 1800 $cm^2$

calculate the surface area of vase **A**.

..... $cm^2$

**(Total for Question 20 is 4 marks)**

# Question 20

3 marks | Area & Volume of Similar Shapes

**20** **R** and **S** are two similar solid shapes.

Shape **R** has surface area 108 $cm^2$ and volume 135 $cm^3$
Shape **S** has surface area 300 $cm^2$

Work out the volume of shape **S**.

..... $cm^3$

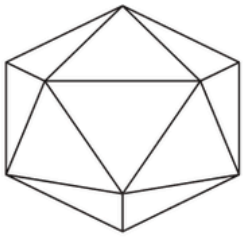
**(Total for Question 20 is 3 marks)**

# Question 20

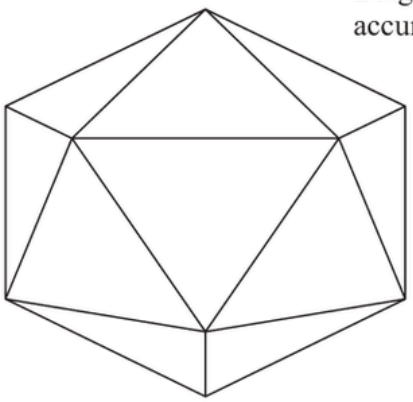
3 marks | Area & Volume of Similar Shapes

**20** **A** and **B** are two similar solids.

Diagram **NOT** accurately drawn



**A**



**B**

**A** has a volume of $1836\,cm^3$
**B** has a volume of $4352\,cm^3$

**B** has a total surface area of $1120\,cm^2$

Work out the total surface area of **A**.

..... $cm^2$

**(Total for Question 20 is 3 marks)**

# Question 20

3 marks | Area & Volume of Similar Shapes

**20** Mathematically similar wooden blocks are made in a workshop.

There are small blocks and there are large blocks.

The volume of each small block is $300\,cm^3$

Given that

the surface area of each small block : the surface area of each large block = 25 : 36

work out the volume of each large block.

..... $cm^3$

**(Total for Question 20 is 3 marks)**

# Question 20

4 marks | Area & Volume of Similar Shapes

**20** The diagram shows two similar metal statues.



A



B

Diagram **NOT** accurately drawn

The volume of statue **B** is 20% less than the volume of statue **A**

The surface area of statue **B** is $k$% less than the surface area of statue **A**

Work out the value of $k$
Give your answer correct to 3 significant figures.

$k$ = .....

**(Total for Question 20 is 4 marks)**

# Question 24

6 marks | Area & Volume of Similar Shapes

**24** The diagram shows a frustum of a cone, and a sphere.

The frustum, shown shaded in the diagram, is made by removing the small cone from the large cone.
The small cone and the large cone are similar.

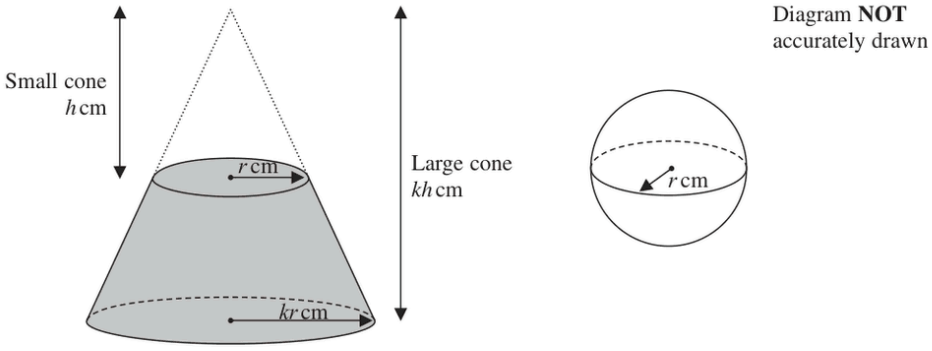



Diagram **NOT** accurately drawn

The height of the small cone is $h$ cm and the radius of the base of the small cone is $r$ cm.
The height of the large cone is $kh$ cm and the radius of the base of the large cone is $kr$ cm.
The radius of the sphere is $r$ cm.

The sphere is divided into two hemispheres, each of radius $r$ cm.

Solid **A** is formed by joining one of the hemispheres to the frustum.
The plane face of the hemisphere coincides with the upper plane face of the frustum, as shown in the diagram below.

Solid **B** is formed by joining the other hemisphere to the small cone that was removed from the large cone.
The plane face of the hemisphere coincides with the plane face of the base of the small cone, as shown in the diagram below.

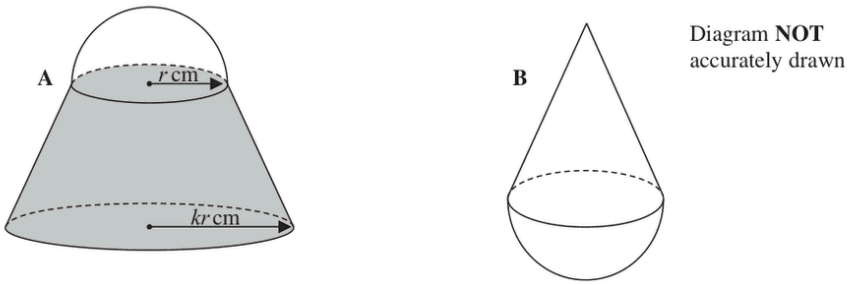



Diagram **NOT** accurately drawn

The volume of solid **A** is 6 times the volume of solid **B**.

Given that $k > \sqrt[3]{7}$

find an expression for $h$ in terms of $k$ and $r$

$h =$ .....

**(Total for Question 24 is 6 marks)**

# Question 23

5 marks | Area & Volume of Similar Shapes

**23** A frustum is made by removing a small square-based pyramid from a similar large squared-based pyramid as shown in the diagram.

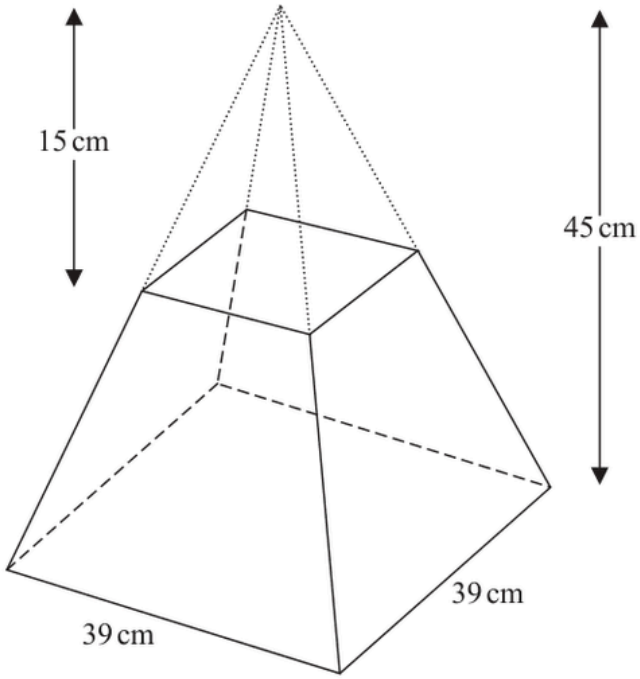



Diagram **NOT** accurately drawn

The height of the small pyramid is 15 cm.
The height of the large pyramid is 45 cm.
The square base of the large pyramid has side length 39 cm.

Work out the **total** surface area of the frustum.
Give your answer correct to the nearest whole number.

..... $cm^2$

**(Total for Question 23 is 5 marks)**

# Question 23

5 marks | Area & Volume of Similar Shapes

**23** Solid **A** is similar to solid **B**

Here is some information about solid **A** and solid **B**

| | solid **A** | solid **B** |
|---|---|---|
| Height (cm) | $3^x$ | |
| Area ($cm^2$) | 7776 | 486 |
| Volume ($cm^3$) | $8^x$ | $2^{x+4}$ |

Work out the height of solid **B**
Give your answer as a decimal.

..... cm

**(Total for Question 23 is 5 marks)**

# Question 23

5 marks | Area & Volume of Similar Shapes

**23** Here is a frustum of a cone.
The frustum is made by removing a small cone from a similar large cone.

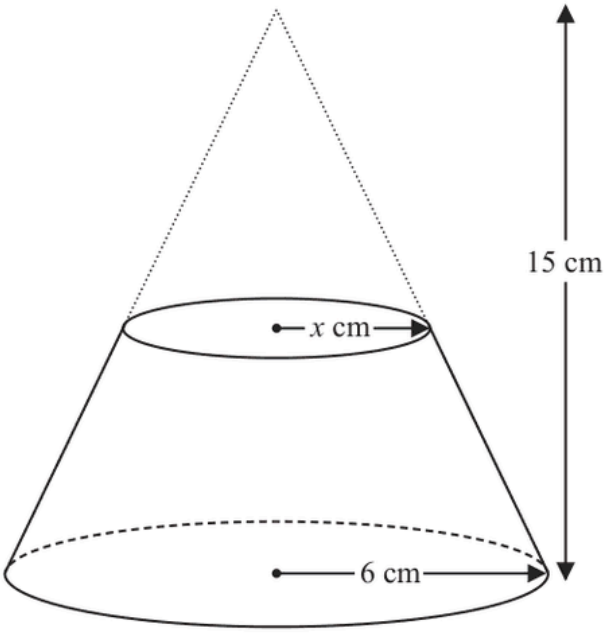



Diagram **NOT** accurately drawn

The height of the large cone is 15 cm.

The radius of the base of the large cone is 6 cm.
The radius of the base of the small cone is $x$ cm.

Given that the volume of the frustum is $\frac{4212}{25}\pi$ cm$^3$

work out the value of $x$
Show clear algebraic working.

$x =$ .....

**(Total for Question 23 is 5 marks)**

# Question 24

5 marks | Area & Volume of Similar Shapes

**24** The diagram shows a solid, **S**, made from a cone and a hemisphere.

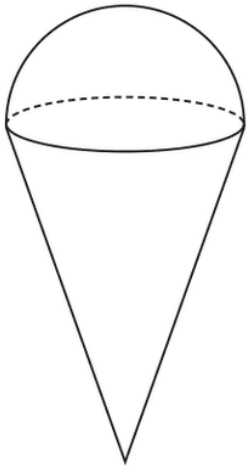


Diagram **NOT** accurately drawn

The centre of the circular face of the cone coincides with the centre of the flat surface of the hemisphere.

The radius of the circular face of the cone, $x$ cm, is equal to the radius of the hemisphere.

The total height of **S** is 4 × the radius of the hemisphere.

A separate sphere has radius $kx$ cm.
The volume of this sphere is 12.5 × the volume of **S**

(a) Work out the value of $k$

$k =$ .....

**(4)**

A solid, **T**, is similar to solid **S**

The volume of **T** is 512 × the volume of **S**

The total surface area of **T** is $d$ × the total surface area of **S**

(b) Find the value of $d$

$d =$ .....

**(1)**

**(Total for Question 24 is 5 marks)**

# Question 25

4 marks | Area & Volume of Similar Shapes

**25** **A** and **B** are two similar solids.

The height of solid **A** is 31 cm
The height of solid **B** is 18.6 cm

Given that

volume of solid **A** − volume of solid **B** = 735 cm³

find the volume of solid **A**

..... cm³

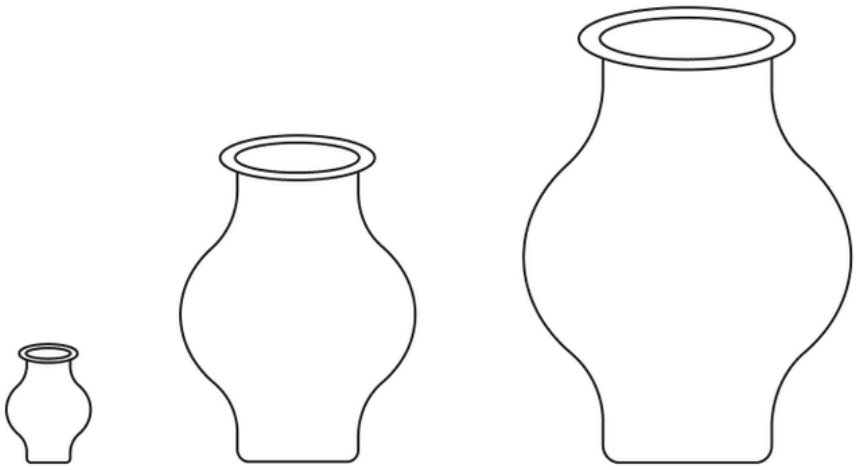
**(Total for Question 25 is 4 marks)**

# Question 26

4 marks | Area & Volume of Similar Shapes

**26** **R**, **S** and **T** are three similar vases.

Diagram **NOT** accurately drawn




The volume of vase **S** is 72.8% more than the volume of vase **R**

The height of vase **R** is $h$ cm
The height of vase **T** is $6h$ cm

The surface area of vase **S** is $A$ cm$^2$
The surface area of vase **T** is $kA$ cm$^2$

Work out the value of $k$

$k =$ .....

**(Total for Question 26 is 4 marks)**

# Question 26

4 marks | Area & Volume of Similar Shapes

**26** **A** and **B** are two similar solids.

The height of solid **A** is 31 cm
The height of solid **B** is 18.6 cm

Given that

volume of solid **A** – volume of solid **B** = 735 cm³

find the volume of solid **A**

..... cm³

**(Total for Question 26 is 4 marks)**

# Question 23

3 marks | Area & Volume of Similar Shapes

**23** Shape **P** is similar to shape **Q**

The table shows some information about shape **P** and shape **Q**

| | **Surface area ($cm^2$)** | **Volume ($cm^3$)** |
|---|---|---|
| Shape **P** | 200 | 672 |
| Shape **Q** | 450 | |

Work out the volume of shape **Q**

..... $cm^3$

**(Total for Question 23 is 3 marks)**

# Question 23

3 marks | Area & Volume of Similar Shapes

**23** Shape **P** is similar to shape **Q**

The table shows some information about shape **P** and shape **Q**

| | Surface area ($cm^2$) | Volume ($cm^3$) |
|---|---|---|
| Shape **P** | 200 | 672 |
| Shape **Q** | 450 | |

Work out the volume of shape **Q**

..... $cm^3$

**(Total for Question 23 is 3 marks)**



TOPIC

# Circle Theorems

Every past-paper question on this topic, 2020 to 2026.

# Question 20

2 marks | Circle Theorems

**20** $A$, $B$ and $C$ are points on a circle.

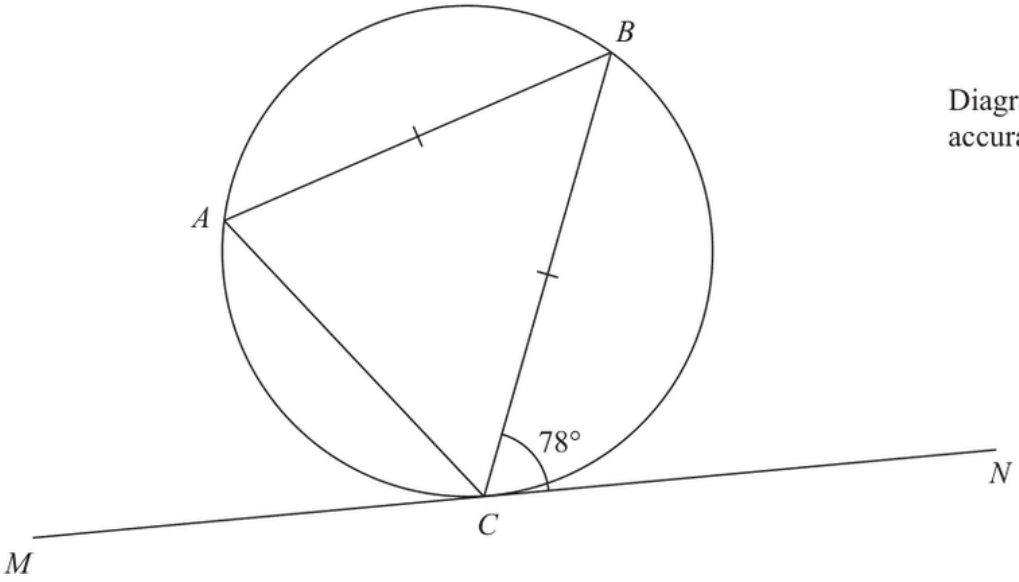



Diagram **NOT** accurately drawn

$MN$ is the tangent to the circle at $C$

$AB = CB$

Angle $BCN = 78°$

Find the size of angle $ABC$

.....°

**(Total for Question 20 is 2 marks)**

# Question 23

5 marks | Circle Theorems

**23**

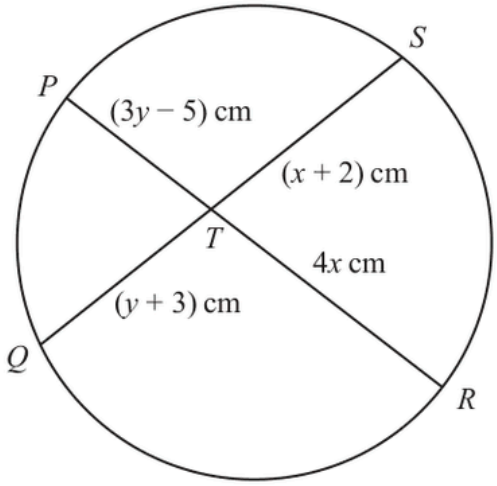



Diagram **NOT** accurately drawn

$PTR$ and $QTS$ are chords of a circle.

$PT = (3y - 5)\,\text{cm}$ $QT = (y + 3)\,\text{cm}$ $RT = 4x\,\text{cm}$ $ST = (x + 2)\,\text{cm}$

Find an expression for $y$ in terms of $x$

$y =$ .....

**Total for Question 23 is 5 marks)**

TOPIC

# Bearings

Every past-paper question on this topic, 2020 to 2026.

# Question 24

6 marks | Bearings

**24** $A$, $B$ and $C$ are three points on horizontal ground.

$AB = 8.4$ metres $BC = 9.2$ metres

$B$ is on a bearing of 067° from $A$
$C$ is on a bearing of 129° from $B$

Calculate the bearing of $A$ from $C$
Give your answer correct to the nearest degree.

.....°

**(Total for Question 24 is 6 marks)**



TOPIC

# Vectors

Every past-paper question on this topic, 2020 to 2026.

# Question 23

5 marks | Vectors

**23**

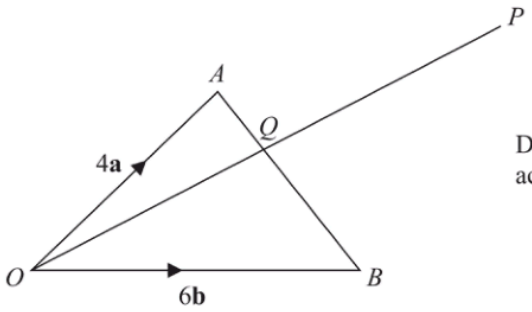



Diagram **NOT** accurately drawn

$OAB$ is a triangle.
$Q$ is the point on $AB$ such that $OQP$ is a straight line.

$\overrightarrow{OA} = \mathbf{4a}$ $\overrightarrow{OB} = \mathbf{6b}$ $\overrightarrow{AP} = \mathbf{2a} + \mathbf{8b}$

Using a vector method, find the ratio $AQ : QB$

$AQ : QB =$ .....

**(Total for Question 23 is 5 marks)**

# Question 23

3 marks | Vectors

**23**

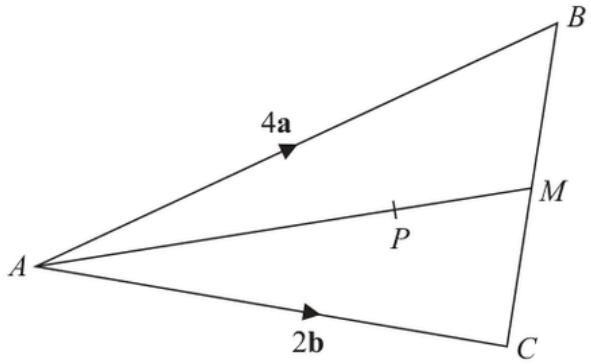



Diagram **NOT** accurately drawn

$ABC$ is a triangle.
The midpoint of $BC$ is $M$.
$P$ is a point on $AM$.

$\overrightarrow{AB} = 4\mathbf{a}$

$\overrightarrow{AC} = 2\mathbf{b}$

$\overrightarrow{AP} = \frac{3}{2}\mathbf{a} + \frac{3}{4}\mathbf{b}$

Find the ratio $AP : PM$

**(Total for Question 23 is 3 marks)**

# Question 26

5 marks | Vectors

**26** The diagram shows trapezium $OACB$.

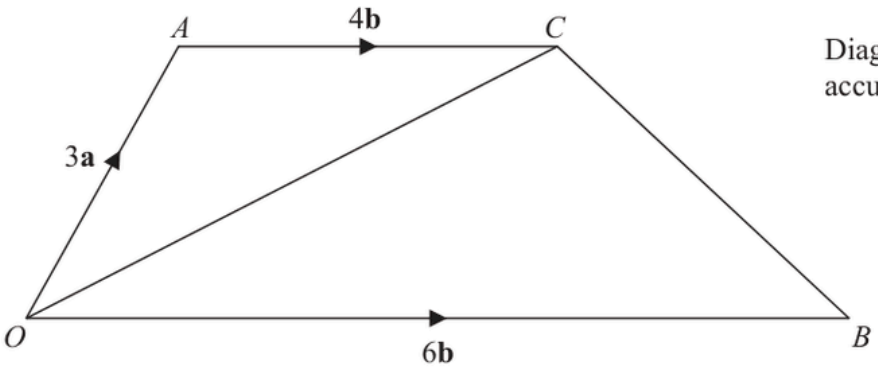



Diagram **NOT** accurately drawn

$\overrightarrow{OA} = 3\mathbf{a}$ $\overrightarrow{OB} = 6\mathbf{b}$ $\overrightarrow{AC} = 4\mathbf{b}$

$N$ is the point on $OC$ such that $ANB$ is a straight line.

Find $\overrightarrow{ON}$ as a simplified expression in terms of **a** and **b**.

**(Total for Question 26 is 5 marks)**

# Question 23

6 marks | Vectors

**23** $OAB$ is a triangle.

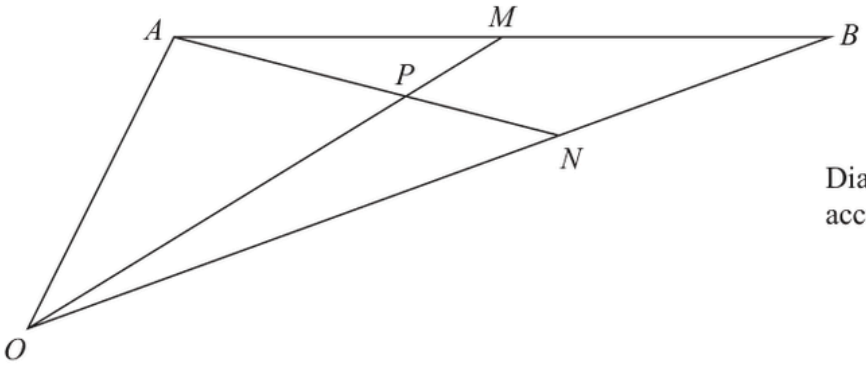



Diagram **NOT** accurately drawn

$\overrightarrow{OA} = 2\mathbf{a}$ and $\overrightarrow{OB} = 2\mathbf{b}$

$M$ is the midpoint of $AB$.
$N$ is the point on $OB$ such that $ON : NB = 2 : 1$

$P$ is the point on $AN$ such that $OPM$ is a straight line.

Use a vector method to find $OP : PM$
Show your working clearly.

**(Total for Question 23 is 6 marks)**

# Question 26

5 marks | Vectors

**26** $OACB$ is a trapezium.

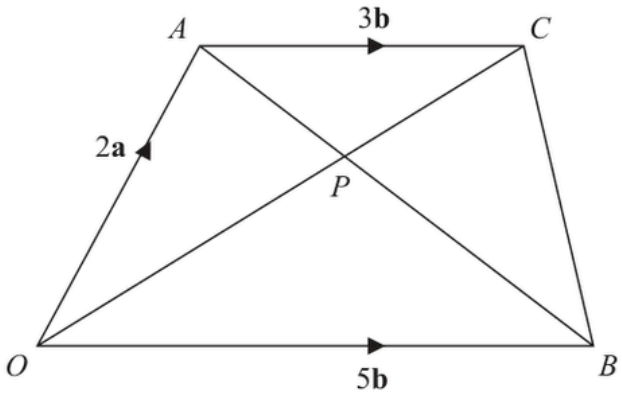



Diagram **NOT** accurately drawn

$\overrightarrow{OA} = \mathbf{2a}$ $\overrightarrow{OB} = \mathbf{5b}$ $\overrightarrow{AC} = \mathbf{3b}$

The diagonals, $OC$ and $AB$, of the trapezium intersect at the point $P$.

Find and simplify an expression, in terms of **a** and **b**, for $\overrightarrow{OP}$
Show your working clearly.

$\overrightarrow{OP} =$ .....

**(Total for Question 26 is 5 marks)**

# Question 22

5 marks | Vectors

**22** The diagram shows triangle $OAB$

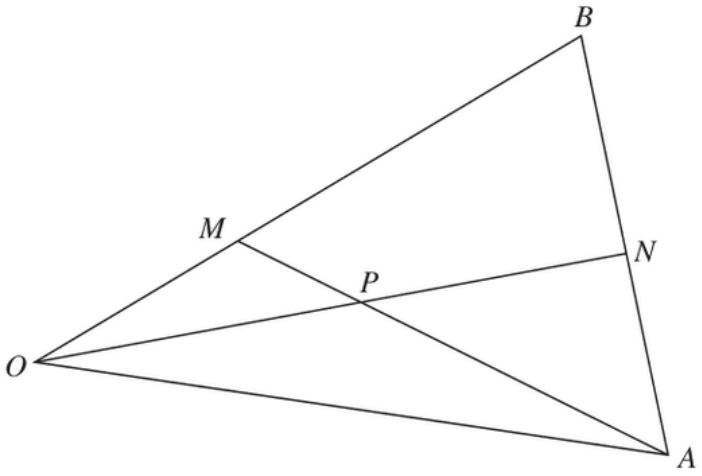



Diagram **NOT** accurately drawn

$\overrightarrow{OA} = 8\mathbf{a}$ $\overrightarrow{OB} = 6\mathbf{b}$

$M$ is the point on $OB$ such that $OM : MB = 1 : 2$
$N$ is the midpoint of $AB$
$P$ is the point of intersection of $ON$ and $AM$

Using a vector method, find $\overrightarrow{OP}$ as a simplified expression in terms of **a** and **b**
Show your working clearly.

$\overrightarrow{OP} =$ .....

**(Total for Question 22 is 5 marks)**

# Question 24

5 marks | Vectors

**24** $OXYZ$ is a trapezium.

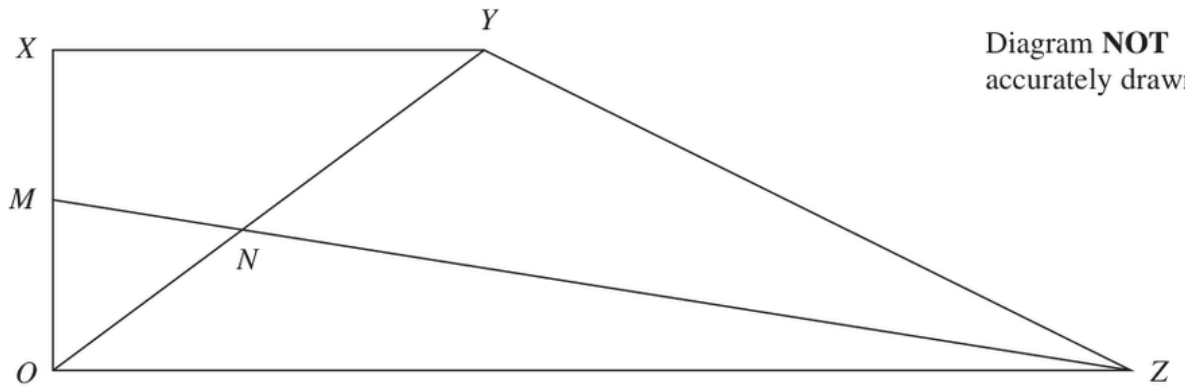



Diagram **NOT** accurately drawn

$\overrightarrow{OX} = \mathbf{a}$

$\overrightarrow{XY} = \mathbf{b}$

$\overrightarrow{OZ} = 3\mathbf{b}$

$M$ is the midpoint of $OX$
$N$ is the point such that $MNZ$ and $ONY$ are straight lines.

Given that $ON : OY = \lambda : 1$

use a vector method to find the value of $\lambda$

$\lambda =$ .....

**(Total for Question 24 is 5 marks)**

# Question 21

5 marks | Vectors

**21**

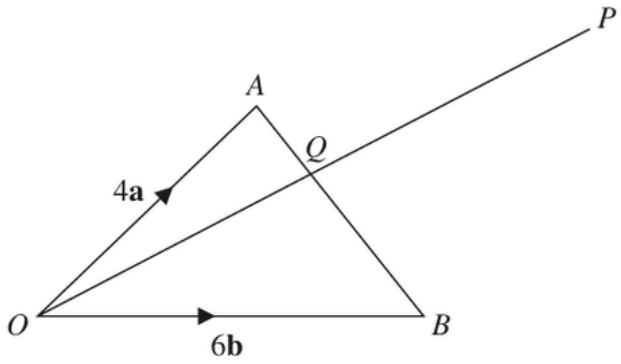



Diagram **NOT** accurately drawn

$OAB$ is a triangle.
$Q$ is the point on $AB$ such that $OQP$ is a straight line.

$\overrightarrow{OA} = 4\mathbf{a}$ $\overrightarrow{OB} = 6\mathbf{b}$ $\overrightarrow{AP} = 2\mathbf{a} + 8\mathbf{b}$

Using a vector method, find the ratio $AQ : QB$

$AQ : QB =$ .....

**(Total for Question 21 is 5 marks)**

# Question 25

5 marks | Vectors

**25** $ABCD$ is a parallelogram and $ADM$ is a straight line.

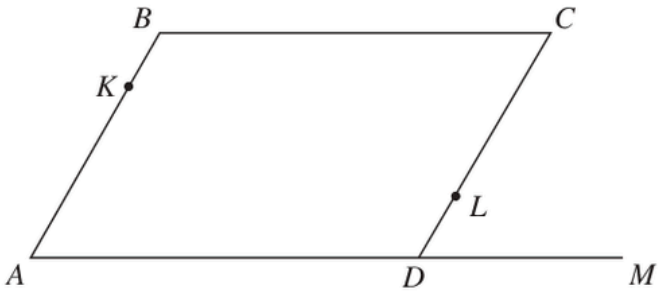



Diagram **NOT** accurately drawn

$\overrightarrow{AB} = \mathbf{a}$ $\overrightarrow{BC} = \mathbf{b}$ $\overrightarrow{DM} = \frac{1}{2}\mathbf{b}$

$K$ is the point on $AB$ such that $AK : AB = \lambda : 1$
$L$ is the point on $CD$ such that $CL : CD = \mu : 1$
$KLM$ is a straight line.

Given that $\lambda : \mu = 1 : 2$

use a vector method to find the value of $\lambda$ and the value of $\mu$

$\lambda =$ .....

$\mu =$ .....

**(Total for Question 25 is 5 marks)**

# Question 22

5 marks | Vectors

**22**

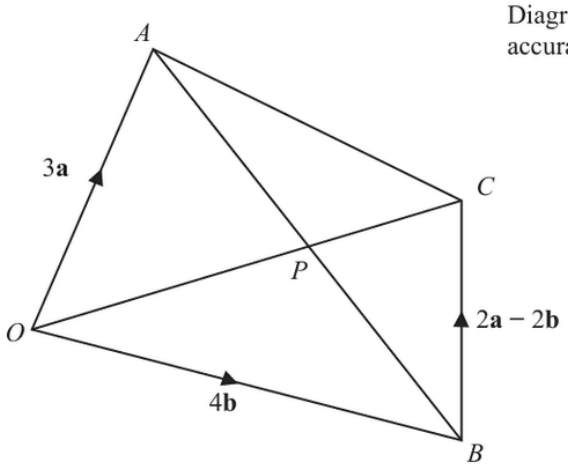



Diagram **NOT** accurately drawn

$OACB$ is a quadrilateral.

$\overrightarrow{OA} = \mathbf{3a}$ $\overrightarrow{OB} = \mathbf{4b}$ $\overrightarrow{BC} = \mathbf{2a} - \mathbf{2b}$

(a) (i) Find the vector $\overrightarrow{OC}$ in terms of **a** and **b**
Simplify your answer.

$\overrightarrow{OC} =$ .....

**(1)**

(ii) Find the vector $\overrightarrow{AB}$ in terms of **a** and **b**

$\overrightarrow{AB} =$ .....

**(1)**

The point $P$ lies on $AB$ and on $OC$

(b) Using a vector method, find the ratio $AP : PB$
Show your working clearly.

.....

**(3)**

**(Total for Question 22 is 5 marks)**

# Question 24

6 marks | Vectors

**24**

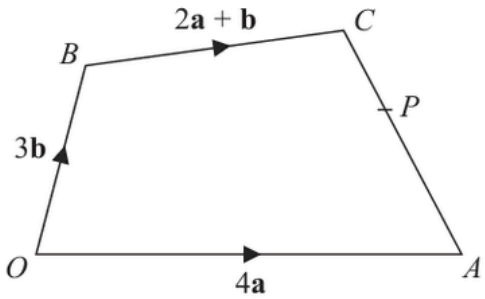



Diagram **NOT** accurately drawn

The diagram shows a quadrilateral $OACB$ in which

$\overrightarrow{OA} = 4\mathbf{a}$ $\overrightarrow{OB} = 3\mathbf{b}$ $\overrightarrow{BC} = 2\mathbf{a} + \mathbf{b}$

(a) Find $\overrightarrow{AC}$ in terms of **a** and **b**
Give your answer in its simplest form.

$\overrightarrow{AC} =$ .....

**(2)**

The point $P$ lies on $AC$ such that $AP : PC = 3 : 2$

The point $Q$ is such that $OPQ$ and $BCQ$ are straight lines.

(b) Using a vector method, find $\overrightarrow{OQ}$ in terms of **a** and **b**
Give your answer in its simplest form.
Show your working clearly.

$\overrightarrow{OQ} =$ .....

**(4)**

**(Total for Question 24 is 6 marks)**

# Question 25

6 marks | Vectors

**25** $OPQR$ is a parallelogram.

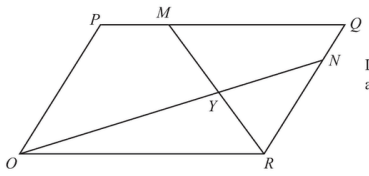



Diagram **NOT** accurately drawn

$\overrightarrow{OP} = 2\mathbf{a}$ and $\overrightarrow{OR} = 3\mathbf{b}$

The point $M$ lies on $PQ$ such that $PM = \frac{1}{4}PQ$

The point $N$ lies on $RQ$ such that $RN = \frac{4}{5}RQ$

(a) Find, in terms of **a** and **b**, giving your answers in simplest form

(i) $\overrightarrow{ON}$

.....

(1)

(ii) $\overrightarrow{MR}$

.....

(1)

$MR$ and $ON$ intersect at the point $Y$

Given that

$$OY = k \times ON$$

(b) use a vector method to find the value of $k$

$k =$ .....

(4)

**(Total for Question 25 is 6 marks)**

# Question 24

6 marks | Vectors

**24** $OAB$ is a triangle.

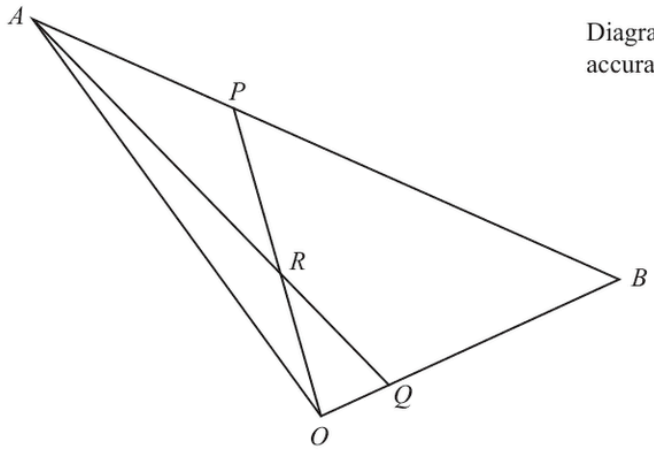



Diagram **NOT** accurately drawn

$\overrightarrow{OA} = 10\mathbf{a}$ $\overrightarrow{OB} = 10\mathbf{b}$

$ARQ$ and $ORP$ are straight lines.

$\overrightarrow{AP} = \frac{1}{4}\overrightarrow{AB}$ and $\overrightarrow{OQ} = \frac{1}{5}\overrightarrow{OB}$

Write the following vectors in terms of **a** and **b**
Simplify your answers.

(i) $\overrightarrow{AQ}$

.....

(1)

(ii) $\overrightarrow{OP}$

.....

(1)

(iii) $\overrightarrow{OR}$

.....

(4)

**(Total for Question 24 is 6 marks)**

# Question 23

5 marks | Vectors

**23**

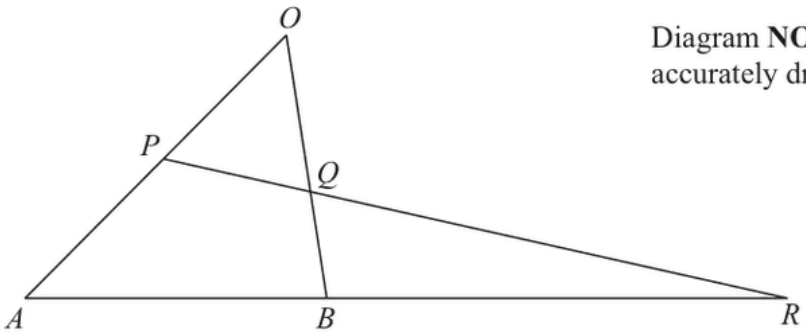



Diagram **NOT** accurately drawn

$OAB$ is a triangle.
$P$ is the midpoint of $OA$
$Q$ is a point on $OB$

$ABR$ and $PQR$ are straight lines.

$\overrightarrow{OA} = 12\mathbf{a}$ $\overrightarrow{OB} = 8\mathbf{b}$

(a) Express $\overrightarrow{AB}$ in terms of **a** and **b**

.....

**(1)**

$AB : BR = 1 : 2$ $\overrightarrow{OQ} = n\mathbf{b}$

(b) Use a vector method to find the value of $n$

$n =$ .....

**(4)**

**(Total for Question 23 is 5 marks)**

# Question 26

5 marks | Vectors

**26**

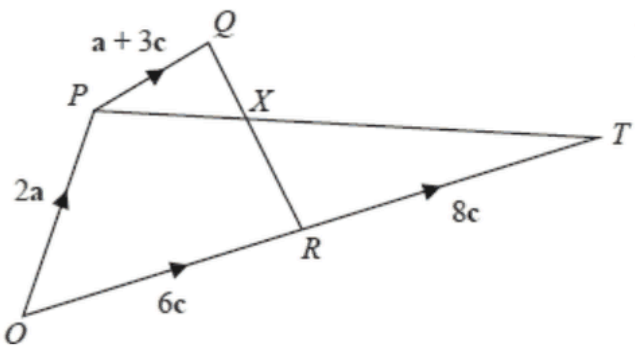



Diagram **NOT** accurately drawn

The diagram shows a quadrilateral $OPQR$ in which

$\overrightarrow{OP} = 2\mathbf{a}$ $\overrightarrow{OR} = 6\mathbf{c}$ $\overrightarrow{PQ} = \mathbf{a} + 3\mathbf{c}$

(a) Find in terms of **a** and **c**

$\overrightarrow{QR}$ = .....

**(1)**

The point $T$ is such that $\overrightarrow{RT} = 8\mathbf{c}$
The point $X$ lies on $QR$ such that $PXT$ is a straight line.

(b) Using a vector method, find the ratio $QX : XR$
Give your answer in the form $m : n$ where $m$ and $n$ are integers.
Show your working clearly.


©2025 Pearson Education Ltd

$QX : XR$ = .....

**(4)**

**(Total for Question 26 is 5 marks)**

# Question 24

6 marks | Vectors

**24** The diagram shows a quadrilateral $OABC$

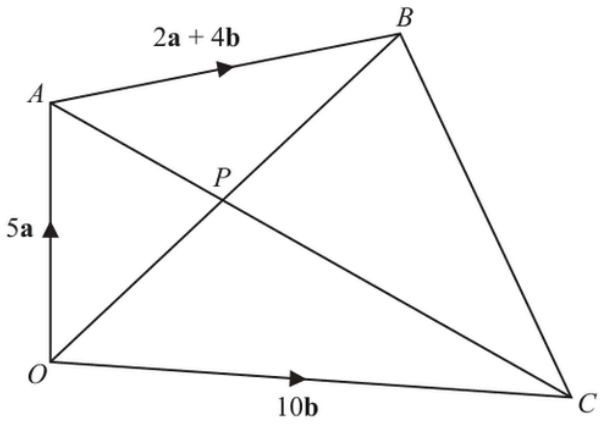



Diagram **NOT** accurately drawn

$\overrightarrow{OA} = 5\mathbf{a}$ $\overrightarrow{OC} = 10\mathbf{b}$ $\overrightarrow{AB} = 2\mathbf{a} + 4\mathbf{b}$

(a) Find $\overrightarrow{AC}$ in terms of **a** and **b**

$\overrightarrow{AC} =$ .....

**(1)**

(b) Find $\overrightarrow{OB}$ in terms of **a** and **b**
Give your answer in its simplest form.

$\overrightarrow{OB} =$ .....

**(1)**

The point $P$ is such that $APC$ and $OPB$ are straight lines.

(c) Using a vector method, find $\overrightarrow{OP}$ in terms of **a** and **b**
Give your answer in its simplest form.
Show your working clearly.

$\overrightarrow{OP} =$ .....

**(4)**

**(Total for Question 24 is 6 marks)**

# Question 27

6 marks | Vectors

**27**

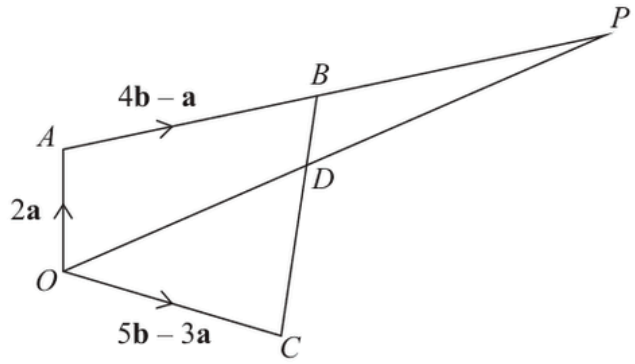



Diagram **NOT** accurately drawn

$OABC$ is a quadrilateral.
$ABP$ and $ODP$ are straight lines.

$\overrightarrow{OA} = \mathbf{2a}$ $\overrightarrow{AB} = \mathbf{4b - a}$ $\overrightarrow{OC} = \mathbf{5b - 3a}$

(a) Find an expression in terms of **a** and **b** for the vector $\overrightarrow{BC}$
Simplify your answer.

.....

**(2)**

The point $D$ lies on $BC$ such that $BD : DC = 1 : 3$

Given that $\overrightarrow{OP} = n\overrightarrow{OD}$

(b) use a vector method to find the value of $n$

$n =$ .....

**(4)**

**(Total for Question 27 is 6 marks)**

TOPIC

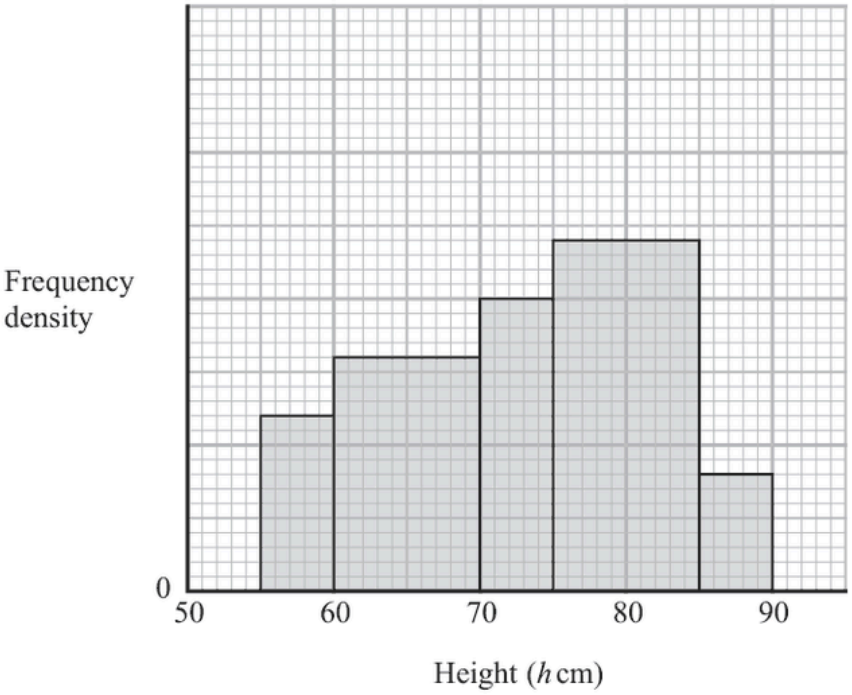
# Histograms

Every past-paper question on this topic, 2020 to 2026.

# Question 20

4 marks | Histograms

**20** The histogram gives information about the heights, $h$ cm, of some tomato plants.




There are 12 tomato plants for which $75 < h \leqslant 85$
One of the tomato plants is selected at random.

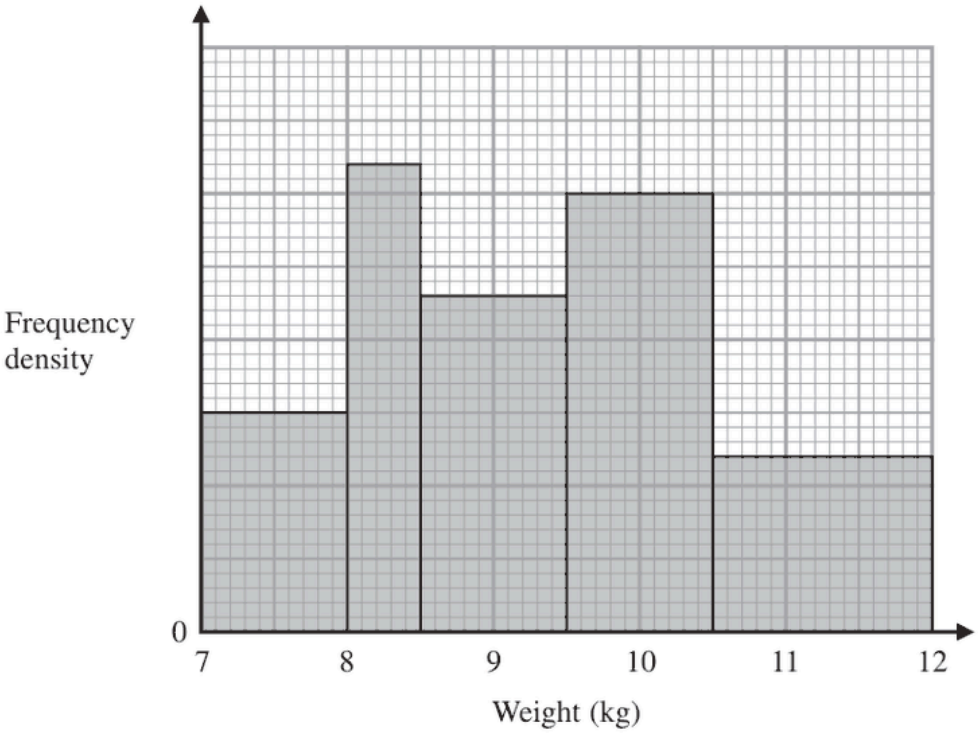
Find an estimate for the probability that this tomato plant has a height greater than 82.5 cm

**(Total for Question 20 is 4 marks)**

# Question 21

3 marks | Histograms

**21**




The histogram gives information about the weights, in kg, of all the watermelons in a field.

There are 16 watermelons with a weight between 8 kg and 8.5 kg

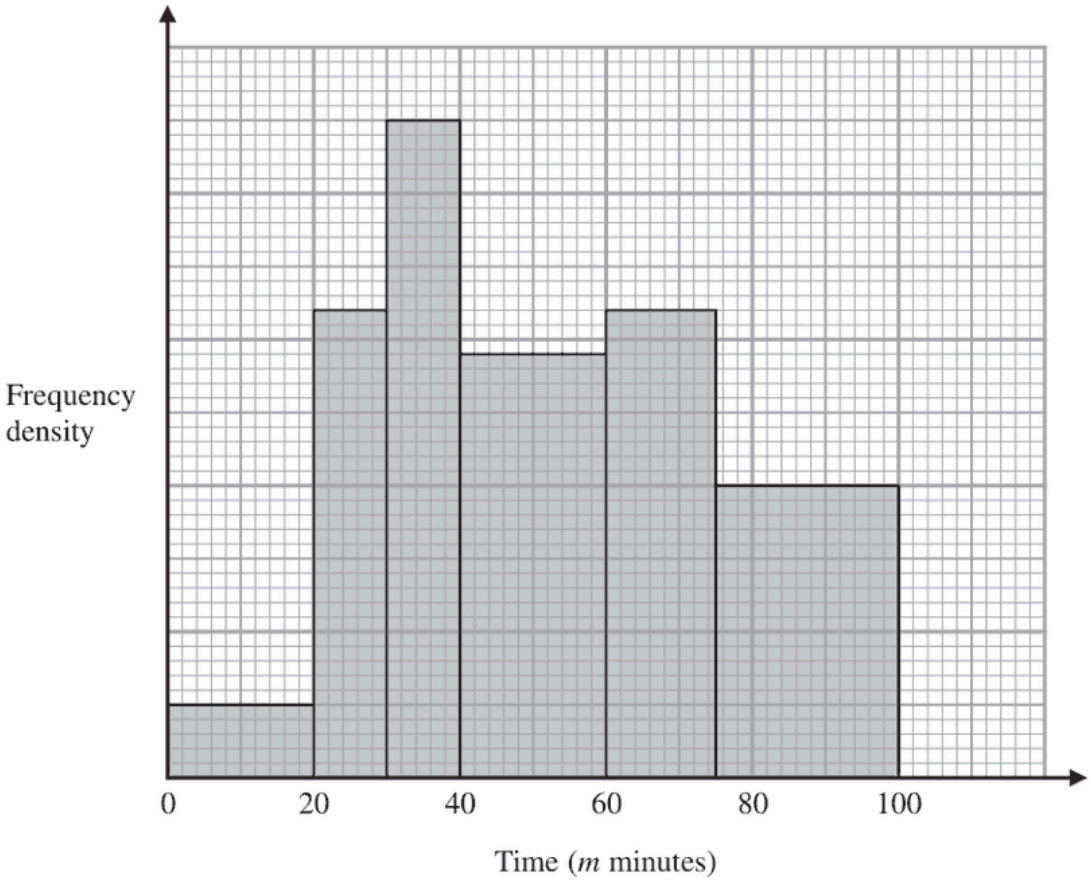
Work out the total number of watermelons in the field.

**(Total for Question 21 is 3 marks)**

# Question 21

3 marks | Histograms

**21** The histogram shows information about the total time, $m$ minutes, taken by each child in a school to walk to school every day for one week.




There are no children for whom $m > 100$
There are 10 children for whom $m \leqslant 20$

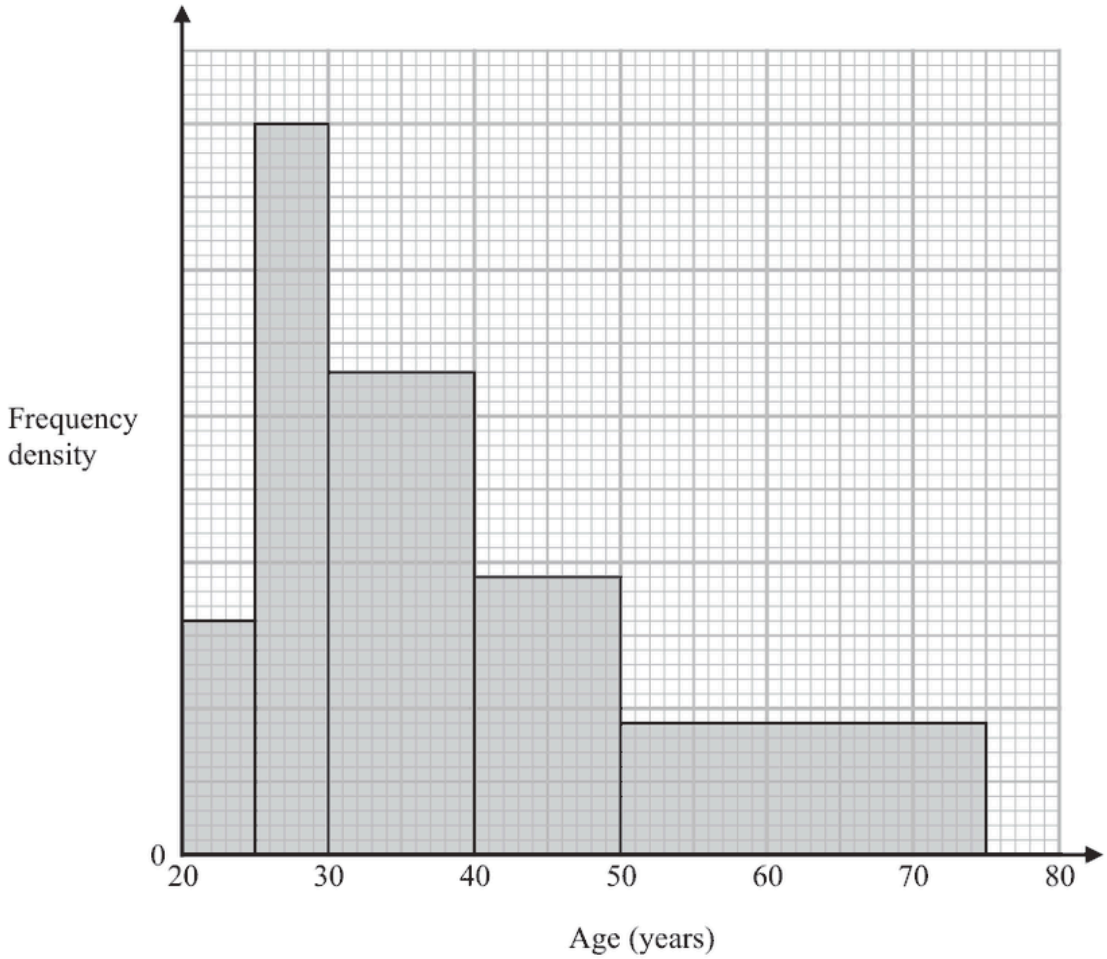
Work out an estimate for the number of children for whom $50 < m \leqslant 80$

**(Total for Question 21 is 3 marks)**

# Question 22

4 marks | Histograms

**22** Some people attend a concert.
The histogram shows information about the ages of these people.




Work out an estimate for the percentage of these people who are aged more than 55 years.
Give your answer correct to one decimal place.

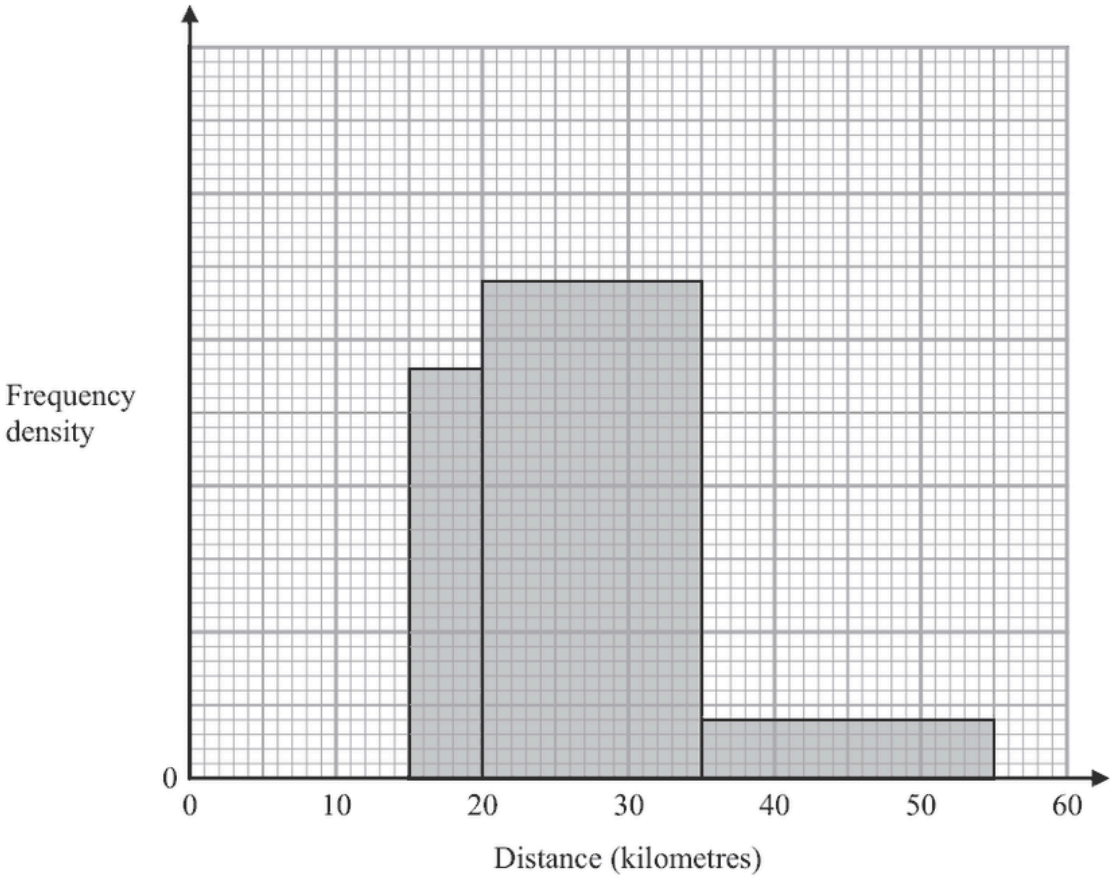
.....%

**(Total for Question 22 is 4 marks)**

# Question 22

3 marks | Histograms

**22** The incomplete histogram shows some information about the distances, in kilometres, that 100 adults ran last week.




All of the adults ran at least 5 kilometres.
None of the adults ran more than 55 kilometres.
14 adults ran between 15 kilometres and 20 kilometres.

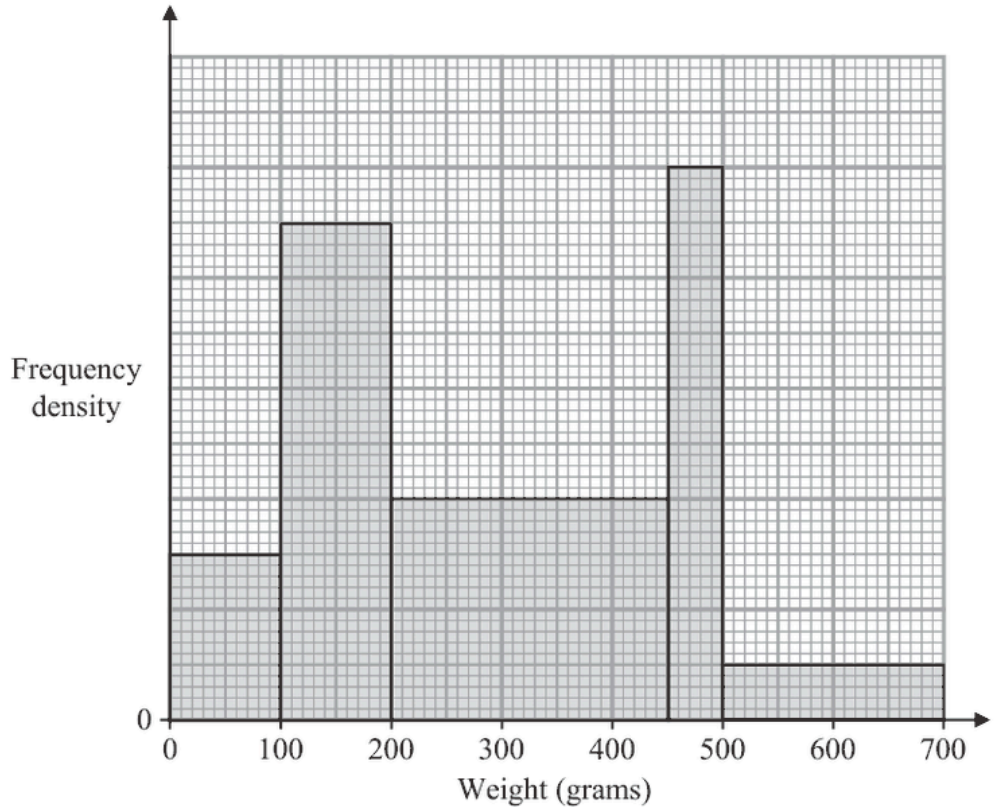
Complete the histogram.

**(Total for Question 22 is 3 marks)**

# Question 20

4 marks | Histograms

**20** The histogram gives some information about the weights, in grams, of some books.




75 books weigh less than 100 grams.

A book is chosen at random.

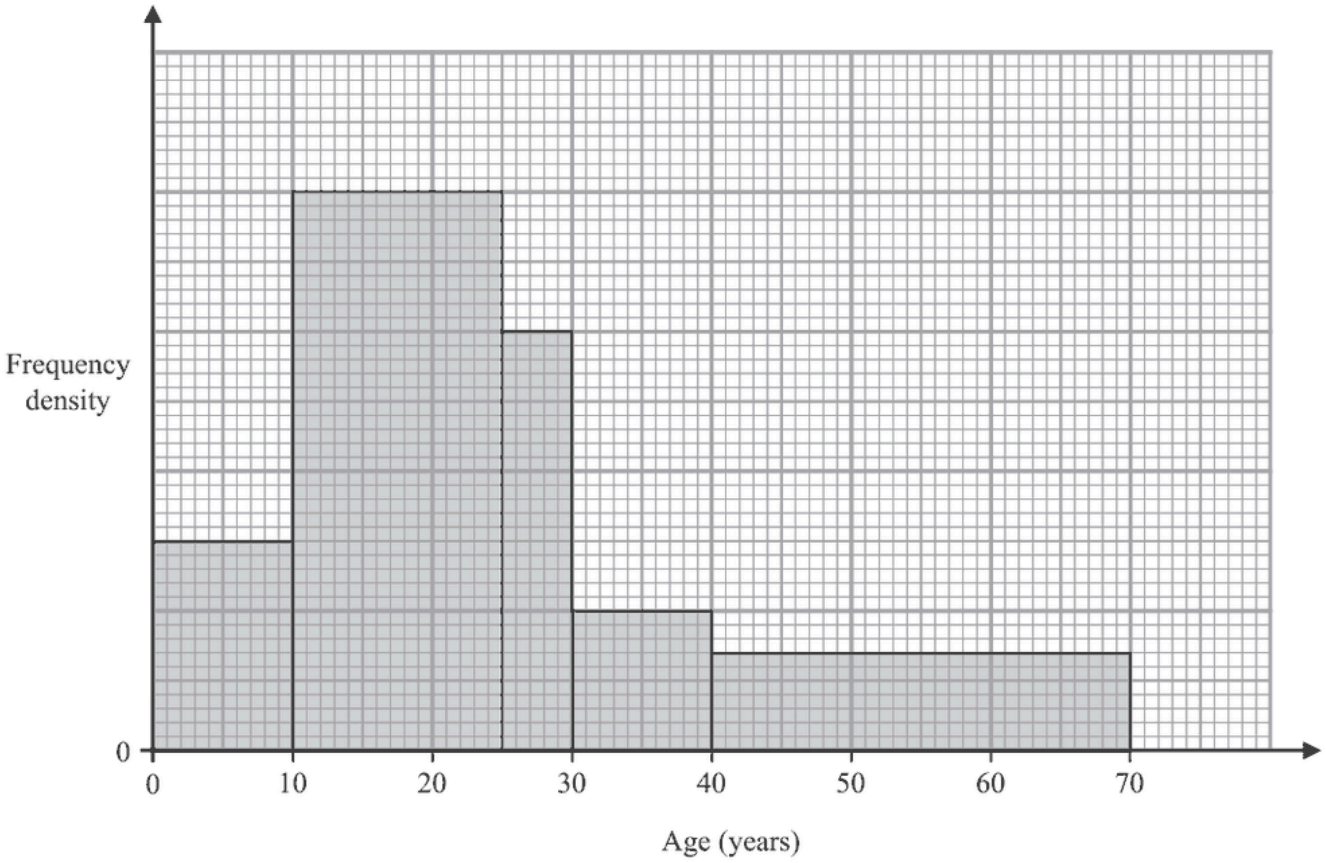
Find an estimate for the probability that this book weighs between 400 grams and 600 grams.

**(Total for Question 20 is 4 marks)**

# Question 21

3 marks | Histograms

**21** The histogram shows information about the ages of the members of a chess club.




There are 60 members aged between 10 and 25
There are no members older than 70

Work out an estimate for the number of members who are over 35 years of age.

**(Total for Question 21 is 3 marks)**

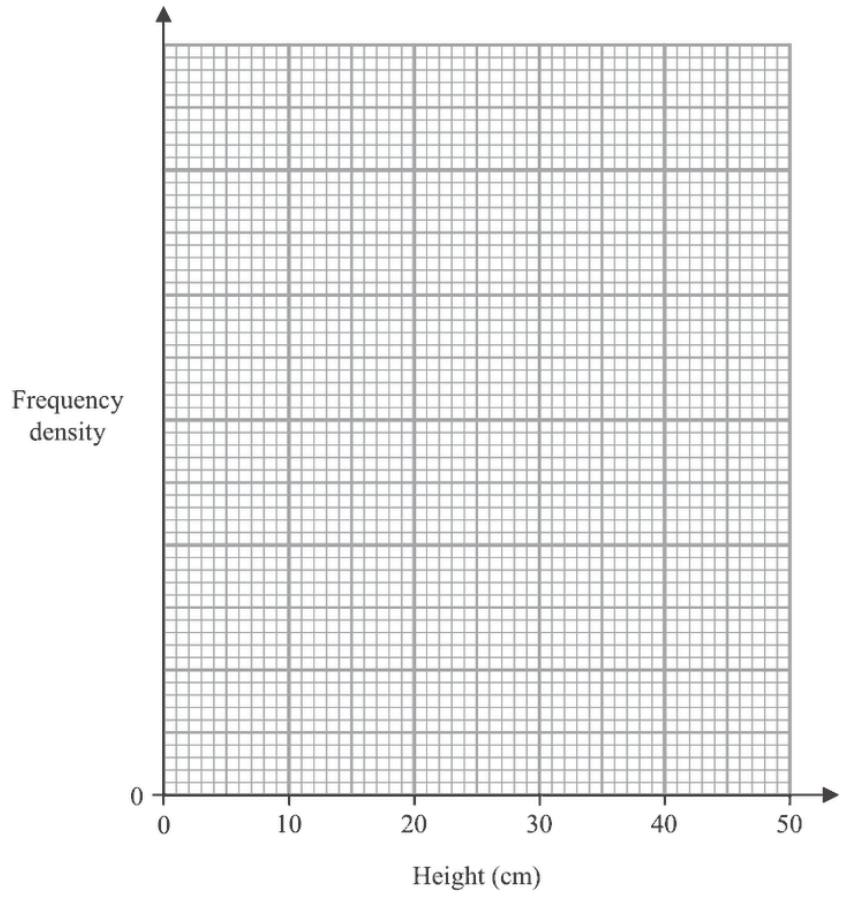
# Question 20

3 marks | Histograms

**20** The table gives information about the heights, in centimetres, of some plants.

| Height ($h$ cm) | Frequency |
|---|---|
| $0 < h \leqslant 5$ | 12 |
| $5 < h \leqslant 15$ | 34 |
| $15 < h \leqslant 30$ | 45 |
| $30 < h \leqslant 50$ | 28 |

On the grid, draw a histogram for this information.
You must include a scale on the vertical axis.

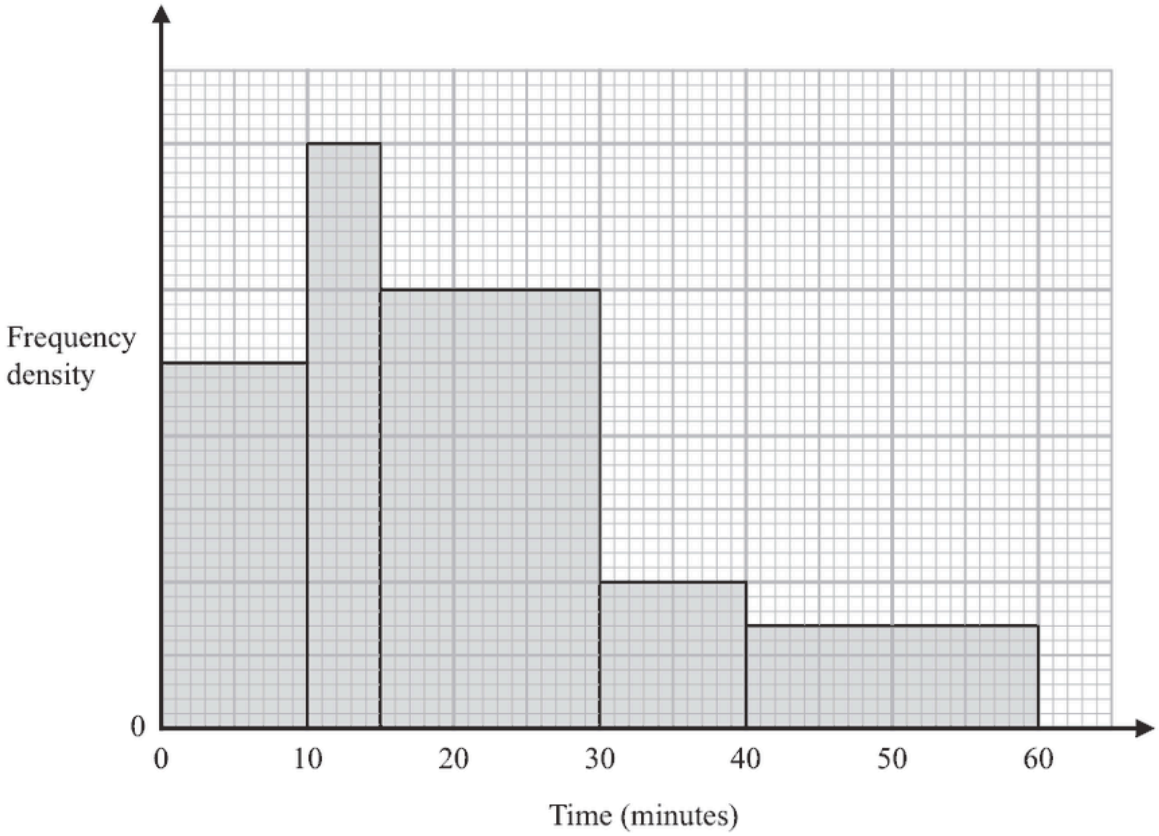



**(Total for Question 20 is 3 marks)**

# Question 21

3 marks | Histograms

**21** The histogram shows information about the times, in minutes, that some trains arrived late at a station one day.




20 of these trains arrived between 10 minutes late and 15 minutes late.

No trains arrived more than 60 minutes late.

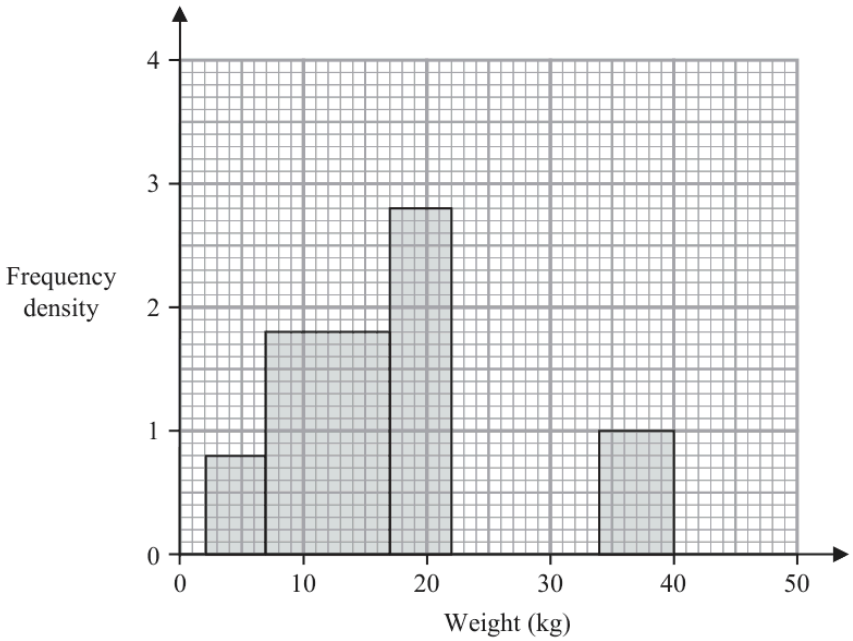
Work out an estimate for the number of these trains that arrived at least 25 minutes late.

**(Total for Question 21 is 3 marks)**

# Question 21

3 marks | Histograms

**21** The incomplete histogram shows information about the weights, in kg, of some parcels.




No parcels weigh less than 2 kg
No parcels weigh more than 40 kg
Half of the parcels weigh between 22 kg and 34 kg

Complete the histogram by drawing a bar to represent the parcels that weigh between 22 kg and 34 kg

**(Total for Question 21 is 3 marks)**

TOPIC

# Probability Toolkit

Every past-paper question on this topic, 2020 to 2026.

# Question 23

4 marks | Probability Toolkit

**23** In a bag, there are only

3 blue beads
4 white beads
and $x$ orange beads.

Jean is going to take at random two beads from the bag.

The probability that Jean will take two beads of the same colour is $\frac{3}{8}$

Find the total number of beads in the bag.
Show clear algebraic working.

**(Total for Question 23 is 4 marks)**

# Question 21

6 marks | Probability Toolkit

**21** A bag contains $n$ beads.
6 of the beads are red and the rest are blue.

Ravi is going to take at random 2 beads from the bag.

The probability that the 2 beads will be of the same colour is $\frac{9}{17}$

Using algebra, and showing each stage of your working, calculate the value of $n$.

$n =$ .....

**(Total for Question 21 is 6 marks)**

# Question 23

5 marks | Probability Toolkit

**23** Pippa has a box containing $N$ pens.

There are only black pens and red pens in the box.
The number of black pens in the box is 3 more than the number of red pens.

Pippa is going to take at random 2 pens from the box.

The probability that she will take a black pen **followed** by a red pen is $\frac{9}{35}$

Find the possible values of $N$.
Show clear algebraic working.

**(Total for Question 23 is 5 marks)**

# Question 24

5 marks | Probability Toolkit

**24** Elliot has $x$ counters.

Each counter has one red face and one green face.

Elliot spreads all the counters out on a table and sees that the number of counters showing a red face is 5

Elliot then picks at random one of the counters and turns the counter over.
He then picks at random a second counter and turns the counter over.

The probability that there are still 5 counters showing a red face is $\frac{19}{32}$

Work out the value of $x$
Show clear algebraic working.

$x =$ .....

**(Total for Question 24 is 5 marks)**

# Question 20

4 marks | Probability Toolkit

**20** A bag contains only 10 cent coins and 20 cent coins.

Josip takes at random a coin from the bag, records its value and replaces it in the bag.
He then takes at random a second coin from the bag, records its value and replaces it in the bag.

Josip finds the mean value of the two coins.

The probability that the two coins have a mean value of 10 cents is $\frac{49}{121}$

Work out the probability that the two coins have a mean value of 15 cents.

**(Total for Question 20 is 4 marks)**

# Question 21

5 marks | Probability Toolkit

**21** There are 25 counters in a bag such that

6 counters are blue
$x$ counters are orange, where $x > 9$
the rest of the counters are pink

Maalam takes at random two of the counters from the bag.

The probability that Maalam takes one orange counter and one pink counter is $\frac{22}{75}$

Calculate the probability that Maalam takes 2 pink counters from the bag.
Show clear algebraic working.

**(Total for Question 21 is 5 marks)**

# Question 21

3 marks | Probability Toolkit

**21** A box contains 20 counters.

9 of the counters are red
7 of the counters are yellow
4 of the counters are green

Alex takes at random three counters from the box.

Work out the probability that exactly two of the three counters are the same colour.

**(Total for Question 21 is 3 marks)**

# Question 22

3 marks | Probability Toolkit

**22** A box contains 20 counters.

9 of the counters are red
7 of the counters are yellow
4 of the counters are green

Alex takes at random three counters from the box.

Work out the probability that exactly two of the three counters are the same colour.

**(Total for Question 22 is 3 marks)**

TOPIC

# Tree Diagrams & Conditional Probability

Every past-paper question on this topic, 2020 to 2026.

# Question 20

3 marks | Tree Diagrams & Conditional Probability

**20** There are 12 counters in a bag.

3 of the counters are red
9 of the counters are green

Ameya, Jack and Ella each take at random one counter from the bag.

Work out the probability that at least one red counter is still in the bag.

**(Total for Question 20 is 3 marks)**

# Question 22

3 marks | Tree Diagrams & Conditional Probability

**22** There are 15 buttons in a box.

3 of the buttons are red
2 of the buttons are pink
10 of the buttons are blue

Pete takes at random three buttons from the box.

Work out the probability that there is still at least one pink button in the box.

**(Total for Question 22 is 3 marks)**

# Question 23

3 marks | Tree Diagrams & Conditional Probability

**23** There are 15 buttons in a box.

3 of the buttons are red
2 of the buttons are pink
10 of the buttons are blue

Pete takes at random three buttons from the box.

Work out the probability that there is still at least one pink button in the box.

**(Total for Question 23 is 3 marks)**

# Question 22

5 marks | Tree Diagrams & Conditional Probability

**22** A bag contains $x$ marbles.
12 of the marbles are pink and the rest are yellow.

Greta takes at random 2 marbles from the bag.

The probability that Greta takes a pink marble and a yellow marble is $\frac{18}{47}$

Work out the value of $x$
Show clear algebraic working.

$x =$ .....

**(Total for Question 22 is 5 marks)**

TOPIC

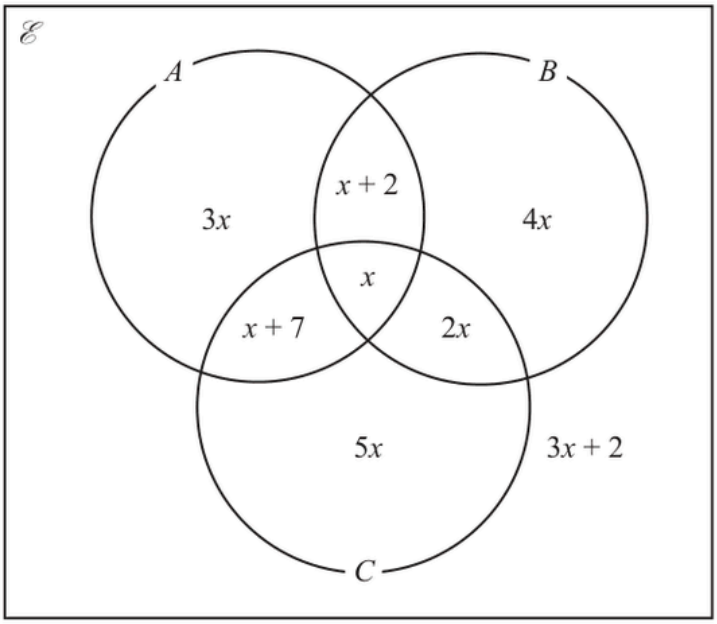
# Set Notation & Venn Diagrams

Every past-paper question on this topic, 2020 to 2026.

# Question 21

4 marks | Set Notation & Venn Diagrams

**21** The Venn diagram shows information about the numbers of items in set $A$, set $B$ and set $C$, where $x$ is an integer.




Given that $n(A \cup B)' = 26$

find $n(A' \cap C)$

$n(A' \cap C) =$ .....

**(Total for Question 21 is 4 marks)**

# Question 20

6 marks | Set Notation & Venn Diagrams

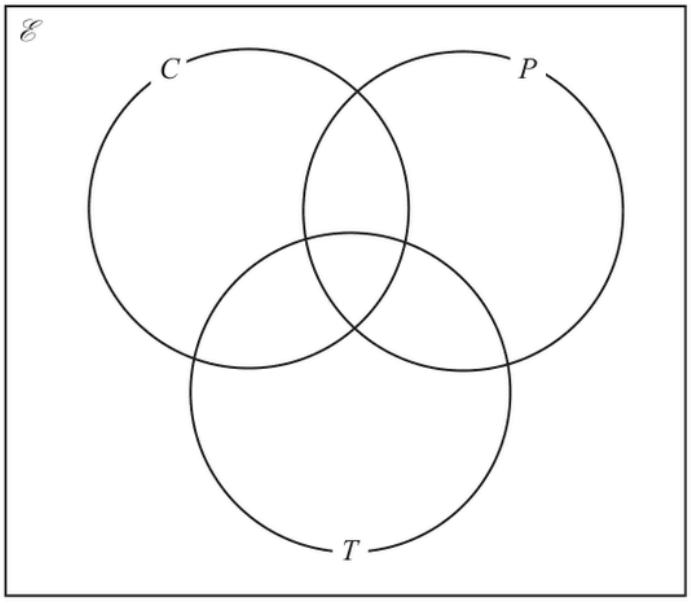
**20** 120 gardeners were asked if they grow carrots ($C$) or potatoes ($P$) or tomatoes ($T$)

Of these gardeners

43 grow carrots
12 grow carrots and potatoes and tomatoes
18 grow carrots and potatoes
27 grow carrots and tomatoes
32 grow potatoes and tomatoes
29 do not grow carrots or potatoes or tomatoes

The number of these gardeners who grow only potatoes is equal to the number of these gardeners who grow only tomatoes.

(a) Complete the Venn diagram to show this information.




**(3)**

(b) Find $n(T' \cap C)$

.....

**(1)**

One of the gardeners who grows carrots is chosen at random.

(c) Calculate the probability that this gardener also grows potatoes.

.....

**(2)**

**(Total for Question 20 is 6 marks)**