ACACIA TUTORING

Linear and Quadratic Equations

9 μnit Test

Free and always will be!

Instructions: Read all questions carefully to ensure you understand what is being asked. When completing your official tests / exams, your grade will be based upon your: **understanding, fluency, reasoning, and problem solving,** so ensure you show all lines of working and draw accurate, labelled diagrams where necessary. (ACiQ|9.0 Mathematics standard elaborations found on final page (general assessment marking standards)). [Practise tests are marked out of a score of 10]. For multiple choice questions, tick or fill in the circle next to the corresponding letter under the question.

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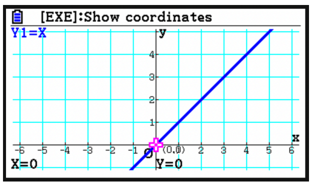
$$\sum = \frac{\quad}{10} = \quad \%$$

Part 1: Multiple Choice (2 marks)

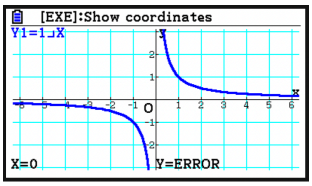
Question 1:

Which of the following is the graph of a quadratic function?

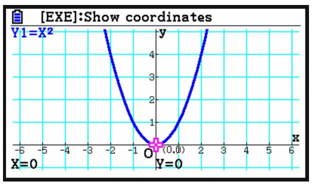
A. A straight line



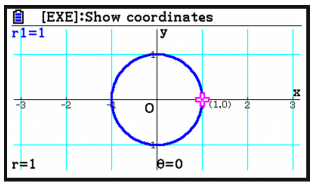
B. A hyperbola



C. A parabola



D. A circle



○ **A** ○ **B** ○ **C** ○ **D**

Space for question 1…

Question 2:

Which equation represents a quadratic function?

A. $y = 3x + 2$ **B.** $y = x^2 - 4x + 4$ **C.** $y = \frac{1}{x}$ **D.** $y = |x|$

○ A ○ B ○ C ○ D

Space for question 2...

Part 2: Short Answer (4 marks)

Question 3:

Identify the vertex and the direction of opening then sketch the graph of the quadratic function: $y = x^2$.

Question 4:

Solve the quadratic equation $x^2 - 5x + 6 = 0$ by factoring.

Part 3: Problem Solving (4 marks)

Question 5:

Given the quadratic function $y = -x^2 + 4x - 3$, Determine the vertex. Sketch the graph.

Question 6:

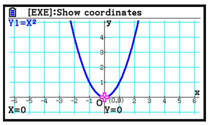
A ball is thrown upward, and its height h (in $metres$) after t seconds can be modelled by the equation $h = -5t^2 + 20t + 1$. Find the maximum height the ball reaches. When does the ball reach its maximum height?

Solutions

1. (1 mark)

C. A parabola.

Quadratic functions graph as parabolas.



2. (1 mark)

B. $y = x^2 - 4x + 4$.

This is the standard form of a quadratic equation, $y = ax^2 + bx + c$.

3. (2 marks)

$$\begin{aligned} & y = x^2 \\ \Rightarrow\ & y = 1x^2 + 0x + 0 \\ & \quad = ax^2 + bx + c \end{aligned}$$

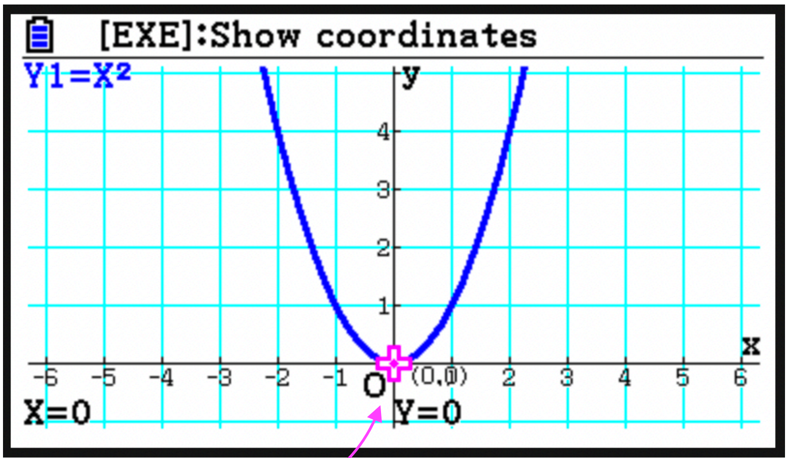
So, $a = 1,\ b = 0,\ c = 0$.

Vertex given by $x = -\dfrac{b}{2a}$

$$\begin{aligned} x &= -\frac{0}{2 \times 1} \\ &= 0. \end{aligned}$$

Sub in $x = 0$ into $y = x^2$,

$$\begin{aligned} \rightarrow y &= 0^2 \\ &= 0. \end{aligned}$$



So vertex at: $(0,\ 0)$

Direction of Opening: Upwards because the coefficient of x^2 is positive (i.e. $a = +1$).
[Description for drawing: A U-shaped curve with the minimum point at the origin, symmetric about the y-axis.]

4. (2 marks)

Find two numbers that multiply to 6 and add to -5, $\Rightarrow\ -2$ and -3:

$$\rightarrow x^2 - 5x + 6$$

$$0 = (x-2)(x-3)$$

$$0 = (x-2)(x-3)$$

$$(x-2) = 0$$

$$\rightarrow x = +2,$$

$$0 = (x-2)(x-3)$$

$$(x-3) = 0$$

$$\rightarrow x = +3.$$

Thus, $x = 2$ and $x = 3$.

5. (2 marks)

$$y = -x^2 + 4x - 3$$
$$= -1x^2 + 4x - 3\,.$$
$$\rightarrow a = -1,\ b = 4,\ c = -3\,.$$

Vertex: Use the formula

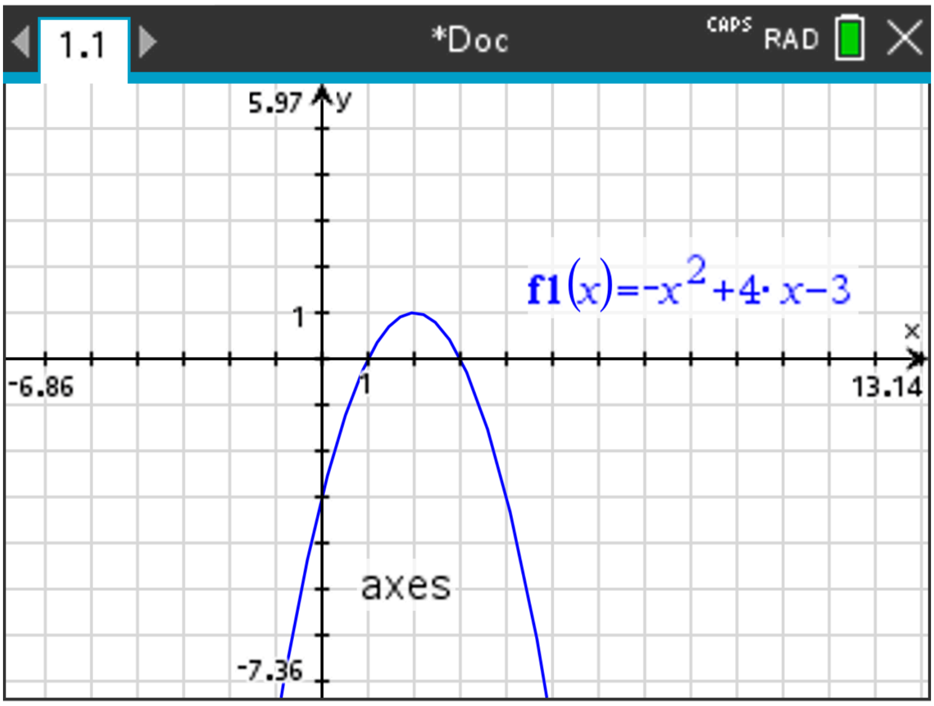
$$x = -\frac{b}{2a} \text{ where } a = -1 \text{ and } b = 4\ :$$
$$x = -\frac{4}{2(-1)}$$
$$= 2\,.$$

Substituting $x = 2$ into the equation for y :

$$y = -(2)^2 + 4(2) - 3$$
$$= -4 + 8 - 3$$
$$= 1\,.$$

So, the vertex is at $(2,\ 1)$.

[Description for sketching: Draw a parabola opening downwards with the vertex at $(2,\ 1)$. The parabola crosses the $y-axis$ at $y = -3$ and has symmetry about $x = 2$.]



6. (2 marks)

$$h = -5t^2 + 20t + 1$$
$$y = ax^2 + bx + c$$
$$\rightarrow a = -5,\ b = 20,\ c = 1\,.$$

Convert to vertex form or use the vertex formula to find the maximum height:

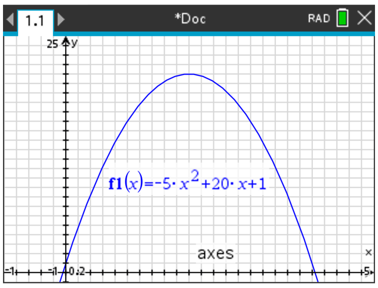
$$\begin{aligned} t &= -\frac{b}{2a} \\ &= -\frac{20}{2(-5)} \\ &= -\frac{20}{2\times -5} \\ &= \frac{-20}{-10} \\ &= \frac{\cancel{-}2\cancel{0}}{\cancel{-}1\cancel{0}} \\ &= \frac{2}{1} \\ &= 2 \text{ seconds}\,. \end{aligned}$$

Substitute $t = 2\ seconds$, into $h = -5t^2 + 20t + 1$ to find height :

At $t = 2$:

$$\begin{aligned} h &= -5(2)^2 + 20(2) + 1 \\ &= -5\times 4 + 40 + 1 \\ &= -20 + 40 + 1 \\ &= 21\, metres\,. \end{aligned}$$

The ball reaches its maximum height of $21\ metres$ at $2\ seconds$.



$$\sum = \frac{\quad}{10} = \quad \%$$

Trigonometry

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$$\sum = \frac{\quad}{10} = \qquad \%$$

Part 1: Multiple Choice (2 marks)

Question 1:

If $\tan(\theta) = \frac{4}{3}$, what is $\sin(\theta)$ in a right-angled triangle where the opposite side to θ is $4\,cm$?

A. $\frac{3}{5}$ **B.** $\frac{4}{5}$ **C.** $\frac{4}{3}$ **D.** $\frac{5}{4}$

○ A ○ B ○ C ○ D

Space for question 1…

Question 2:

What is the angle whose $cosine$ is $\frac{1}{2}$?

A. 30° **B.** 45° **C.** 60° **D.** 90°

○ A ○ B ○ C ○ D

Space for question 2…

Part 2: Short Answer (4 marks)

Question 3:

Calculate the height of a tree if you are standing $20\,metres$ away from its base and the angle of elevation to the top of the tree is 40°. Use $\tan(40^\circ) \approx 0.839$.

Question 4:

A ramp is inclined at an angle of 30° to the ground. If the length of the ramp is $5\,metres$, how far up the wall does the ramp reach? Use $\sin(30^\circ) = \frac{1}{2}$.

Part 3: Problem Solving (4 marks)

Question 5:

A guide wire is attached to the top of an antenna and to a point on the ground $15\,metres$ from the base of the antenna. If the wire makes an angle of 60° with the ground, how long is the wire? Use $\cos(60^\circ) = \frac{1}{2}$.

Question 6:

From the top of a cliff $50\,metres$ high, the angle of depression to a boat at sea is 35°. How far is the boat from the base of the cliff? Use $\tan(35^\circ) \approx 0.700$.

$$\sum = \frac{\quad}{10} = \qquad \%$$

Solutions

1. (1 mark)

B . $\frac{4}{5}$.

Using the Pythagorean theorem, the hypotenuse is $\sqrt{4^2 + 3^2} = 5$.
Thus,

$$\begin{aligned} \sin(\theta) &= \frac{\text{opposite}}{\text{hypotenuse}} \\ &= \frac{4}{5} . \end{aligned}$$

2. (1 mark)

A . 30° .

$$\cos(30^\circ) = \frac{1}{2} .$$

3. (2 marks)

$$\begin{aligned} \tan(\theta) &= \frac{Opposite}{Adjacent} \\ \tan(40^\circ) &= \frac{\text{height}}{\text{distance from the base}} \\ 0.839 &\approx \frac{h}{20} \\ 0.839 \times 20 &\approx \frac{h}{\cancel{20}} \times \cancel{20} \\ 0.839 \times 20 &\approx h \\ h &\approx 20 \times 0.839 \\ &\approx 16.78\, metres . \end{aligned}$$

4. (2 marks)

$$\sin(\theta) = \frac{Opposite}{Hypotenuse}$$

$$\sin(30^\circ) = \frac{\text{height reached}}{\text{ramp length}}$$

$$\frac{1}{2} = \frac{h}{5}$$

$$\frac{1}{2} \times 5 = \frac{h}{\cancel{5}} \times \cancel{5}$$

$$\frac{1}{2} \times 5 = h$$

$$h = 5 \times \frac{1}{2}$$

$$= 2.5\, metres.$$

5. (2 marks)

$$\cos(\theta) = \frac{Adjacent}{Hypotenuse}$$

$$\cos(60^\circ) = \frac{15}{\text{wire length}}$$

$$\frac{1}{2} = \frac{15}{\text{wire length}}$$

$$\frac{1}{2} \times \text{wire length} = \frac{15}{\cancel{\text{wire length}}} \times \cancel{\text{wire length}}$$

$$\frac{1 \times \text{wire length}}{2} = 15$$

$$\frac{\text{wire length}}{\cancel{2}} \times \cancel{2} = 15 \times 2$$

$$\text{wire length} = 15 \times 2$$

$$= 30\, metres.$$

6. (2 marks)

The angle of depression equals the angle of elevation. Therefore :

$$\tan(\theta) = \frac{Opposite}{Hypotenuse}$$

$$\tan(35^\circ) = \frac{\text{height of cliff}}{\text{distance from cliff}}$$

$$0.700 \times d = \frac{50}{\cancel{d}} \times \cancel{d}$$

$$0.700 \times d = 50$$

$$\frac{\cancel{0.700} \times d}{\cancel{0.700}} = \frac{50}{0.700}$$

$$d = \frac{50}{0.700}$$

$$\approx 71.43\, metres.$$

Volume and Surface Area

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Part 1: Multiple Choice (2 marks)

Question 1:

The formula for the volume of a pyramid is:

A. $V = \frac{1}{2} \times$ Base Area $\times$ Height

B. $V =$ Base Area $\times$ Height

C. $V = \frac{1}{3} \times$ Base Area $\times$ Height

D. $V = 2 \times$ Base Area $\times$ Height

○ A ○ B ○ C ○ D

Space for question 1…

Question 2:

What shape is formed when a cone is cut parallel to its base and the top piece is discarded?

A. A smaller cone **B.** A cylinder **C.** A sphere **D.** A frustum of a cone

◯ A ◯ B ◯ C ◯ D

Space for question 2…

Part 2: Short Answer (4 marks)

Question 3:

Calculate the volume of a pyramid with a square base of side length $6\,cm$ **and a height of** $8\,cm$ **.**

Question 4:

Find the surface area of a cylinder with a radius of $3\,cm$ and a height of $10\,cm$. Use $\pi \approx 3.14$.

Part 3: Problem Solving (4 marks)

Question 5:

A cone has a radius of $4\,cm$ and a slant height of $5\,cm$. Calculate the curved surface area of the cone. If the height of the cone is $3\,cm$, find the volume. Use $\pi \approx 3.14$.

Question 6:

A frustum of a cone has the following dimensions: the smaller radius is $2\,cm$, the larger radius is $4\,cm$, and the height is $6\,cm$. Calculate its volume.

Solutions

1. (1 mark)

$C\,.\ V = \frac{1}{3} \times \text{Base Area} \times \text{Height}\,.$

This is the correct formula for the volume of any pyramid.

2. (1 mark)

D. A frustum of a cone.

Cutting a cone parallel to its base results in a frustum of a cone, which is essentially a cone with the top portion removed.

3. (2 marks)

$$V = \frac{1}{3} \times \text{Base Area} \times \text{Height}$$

$$\begin{aligned}\text{Base Area} &= 6 \times 6 \\ &= 36\,cm^2\,.\end{aligned}$$

$$\begin{aligned}V &= \frac{1}{3} \times 36 \times 8 \\ &= 12 \times 8 \\ &= 96\,cm^3\,.\end{aligned}$$

4. (2 marks)

$$\begin{aligned}\text{Surface Area} &= 2\pi r^2 + 2\pi rh \\ &= 2 \times 3.14 \times 3^2 + 2 \times 3.14 \times 3 \times 10 \\ &= 2 \times 3.14 \times 9 + 2 \times 3.14 \times 30 \\ &= 56.52 + 188.4 \\ &= 244.92\,cm^2\,.\end{aligned}$$

5. (2 marks)

Curved Surface Area:

$$\begin{aligned}\text{Curved Surface Area} &= \pi rl \\ &= 3.14 \times 4 \times 5 \\ &= 62.8\,cm^2\,,\end{aligned}$$

$Volume:$

$$\begin{aligned}V &= \frac{1}{3}\pi r^2 h \\ &= \frac{1}{3} \times 3.14 \times 4^2 \times 3 \\ &= \frac{1}{3} \times 3.14 \times 16 \times 3 \\ &= 50.24\,cm^3\,.\end{aligned}$$

6. (2 marks)

Volume of a frustum = Volume of larger cone − Volume of smaller cone cut off :

$$V_{\text{frustum}} = \frac{1}{3}\pi R^2 h_1 - \frac{1}{3}\pi r^2 h_2$$

$$V_{\text{frustum}} = \frac{1}{3}\pi (R^2 h_1 - r^2 h_2)$$

Here, $R = 4\,cm$, $r = 2\,cm$, $h = 6\,cm$.

First, find the height of the larger cone :

$$\text{Similarity ratio} = \frac{R}{r}$$

$$= \frac{4}{2}$$

$$= 2 .$$

Thus, the height of the large cone is $h_1 = 2 \times 6$

$$= 12\,cm .$$

Hence, $h_2 = 12 - 6$

$$= 6\,cm$$

$$V_{\text{frustum}} = \frac{1}{3}\pi(4^2 \times 12 - 2^2 \times 6)$$

$$= \frac{1}{3}\pi(192 - 24)$$

$$= \frac{1}{3}\pi \times 168$$

$$\approx 175.93\,cm^3 .$$

$$\sum = \frac{\quad}{10} = \quad \%$$

General Assessment Marking Standards

Remember: When your official tests are marked, they won't be a score out of 10, they will be a grade (A,B,C,D,E) based on the following standards:

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Year 9 Mathematics standard elaborations

		A	B	C	D	E
		The folio of student work contains evidence of the following:				
Mathematical proficiencies	Understanding	accurate and consistent identification, representation, description and connection of mathematical concepts and relationships in complex unfamiliar, complex familiar, and simple familiar situations	accurate identification, representation, description and connection of mathematical concepts and relationships in complex familiar and simple familiar situations	identification, representation, description and connection of mathematical concepts and relationships in simple familiar situations	partial identification, representation and description of mathematical concepts and relationships in some simple familiar situations	fragmented identification, representation and description of mathematical concepts and relationships in isolated and obvious situations
	Fluency	choice, use and application of comprehensive facts, definitions, and procedures to find solutions in complex unfamiliar, complex familiar, and simple familiar situations	choice, use and application of effective facts, definitions, and procedures to find solutions in complex familiar and simple familiar situations	choice, use and application of facts, definitions, and procedures to find solutions in simple familiar situations	choice and use of partial facts, definitions, and procedures to find solutions in some simple familiar situations	choice and use of fragmented facts, definitions and procedures to find solutions in isolated and obvious situations
	Reasoning	comprehensive explanation of mathematical thinking, strategies used, and conclusions reached in complex unfamiliar, complex familiar, and simple familiar situations	detailed explanation of mathematical thinking, strategies used, and conclusions reached in complex familiar and simple familiar situations	explanation of mathematical thinking, strategies used, and conclusions reached in simple familiar situations	partial explanation of mathematical thinking, strategies used, and conclusions reached in some simple familiar situations	fragmented explanation of mathematical thinking, strategies used, and conclusions reached in isolated and obvious situations
	Problem-solving	purposeful use of problem-solving approaches to find solutions to problems.	effective use of problem-solving approaches to find solutions to problems.	use of problem-solving approaches to find solutions to problems.	partial use of problem-solving approaches to make progress towards finding solutions to problems.	fragmented use of problem-solving approaches to make progress towards finding solutions to problems.

Key shading emphasises the qualities that discriminate between the A–E descriptors