

3. GAC016 Mathematics III: Calculus & Advanced Applications

Starter Quiz ·

GAC Mathematics

Name: _____ Score: _____

1. What does the derivative of a function at a point measure?

- ☐ The value of the function there
- ☐ The rate of change there, which is the gradient of the tangent
- ☐ The average change over the whole curve
- ☐ The area under the curve up to there

2. Integrate x^3 with respect to x . Include the constant.

3. A closed cylinder with flat top and bottom must hold 500 cm^3 . Ignoring seams, find the radius minimising surface area for positive radius, to 2 decimal places.

4. Differentiate $y = x^5$. Give the derivative.

5. A definite integral needs a constant of integration.

- ☐ True ☐ False

6. A balloon's radius grows at a known rate and you want how fast its volume grows. What do you write first?

- ☐ The volume formula alone
- ☐ An integral
- ☐ $dV/dt = dV/dr \times dr/dt$
- ☐ The surface area formula

7. Which rule differentiates $y = (3x + 1)^4$?

- ☐ The quotient rule
- ☐ The power rule alone
- ☐ The chain rule
- ☐ The product rule

8. Evaluate the integral of x^2 from 0 to 3.

9. For the finite region enclosed by two intersecting curves, what must you find to determine its integration bounds?

- ☐ Their second derivatives
- ☐ Their points of intersection
- ☐ Their stationary points
- ☐ Their derivatives

10. $y = x^3 - 3x$ has a stationary point at a positive value of x . What is it?

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Answers ·

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1. The rate of change there, which is the gradient of the tangent

Where it exists, the derivative is an instantaneous limiting rate of change and tangent gradient. A definite integral measures signed accumulation, which need not equal geometric area.

2. $x^4/4 + c$

Add one to the power and divide by the new power, then add c because any constant differentiates to zero.

3. 4.3

$A(r) = 2\pi r^2 + 1000/r$ for $r > 0$. Its derivative gives $r^3 = 250/\pi$, so $r \approx 4.30$ cm. The positive second derivative and divergent endpoint areas justify the global minimum.

4. $5x^4$

Bring the power down and reduce it by one: $5x^4$.

5. False

The constant cancels in $F(b) - F(a)$. Only an indefinite integral needs it – and there it is compulsory.

6. $dV/dt = dV/dr \times dr/dt$

Write the chain first, then fill in each factor. It turns the question into two ordinary derivatives.

7. The chain rule

A function inside a function. The derivative is $4(3x + 1)^3 \times 3 = 12(3x + 1)^3$.

8. 9

$[x^3/3]$ from 0 to 3 = $27/3 - 0 = 9$.

9. Their points of intersection

Find the relevant intersections, determine which curve is upper on each interval, and split if their order changes. A question specifying an external interval can instead supply the bounds directly.

10. 1

$dy/dx = 3x^2 - 3 = 0$ gives $x = \pm 1$, so the positive one is $x = 1$.