"Feeling that you know something isn't reliable. Instead students should wait and self-test to determine their knowledge"

Dan Willingham
Learning and the Brain 2022

Source: Kent Wetzel: https://twitter.com/KentWetzelFCPS/status/1510586212238737415/photo/1

1

Integration

$$I = 4\int_0^1 \sqrt{1-x^2}\,dx$$

As difficult a problem as thou finding quadrature of a circle

http://nm.mathforcollege.com

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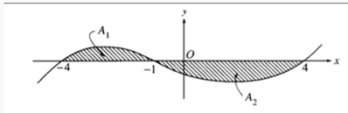
Given the $f(x)$ vs x curve, and the magnitude of the areas A_1 and A_2 as shown, the value of $\int_4^{-4} f(x)dx$ is



$A_2 - A_1$
$A_1 - A_2$
$-A_1 - A_2$
$A_1 + A_2$
Cannot be determined

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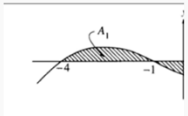
4

Given the $f(x)$ vs x curve, and the magnitude of the areas A_1 and A_2 as shown, the value of $\int_{-4}^{4} f(x)dx$ is



- $A_2 - A_1$
- $A_1 - A_2$
- $A_1 + A_2$
- $-A_1 - A_2$
- Cannot be determined

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5

The exact mean value of the function [*loading eqn.*] from [*loading eqn.*] to [*loading eqn.*] is

- $\frac{f(a)+f(b)}{2}$
- $\frac{f(a)+2f\left(\frac{a+b}{2}\right)+f(b)}{4}$
- $\int_a^b f(x)dx$
- $\frac{\int_a^b f(x)dx}{(b-a)}$

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PHYSICAL EXAMPLES

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Distance Covered By Rocket

$$x = \int_{t_0}^{t_1} \left[u \log_e \left(\frac{m_0}{m_0 - qt} \right) - gt \right] dt$$

$$x = \int_{8}^{30} \left(2000 \ln \left[\frac{140000}{140000 - 2100t} \right] - 9.8t \right) dt$$

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Concentration of Benzene

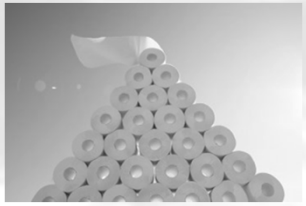
$$erfc(x) = \int_{\infty}^{x} e^{-z^2}\,dz$$

$$c(x,t) = \frac{c_0}{2}\left[erfc\left(\frac{x-ut}{2\sqrt{Dt}}\right) + e^{\frac{ux}{D}}erfc\left(\frac{x+ut}{2\sqrt{Dt}}\right)\right]$$

u= velocity of ground water flow in the x -direction (m/s)
D = dispersion coefficient (m^2/s)
C_0= initial concentration (kg/m^3)

Is Wal*** "short shifting" you?

$$P(y \ge a) = \int_a^{\infty} f(y)dy = \int_a^{\infty} \frac{1}{\sigma\sqrt{2\pi}} e^{-(1/2)[(y-\mu)/\sigma]^2}\,dy$$

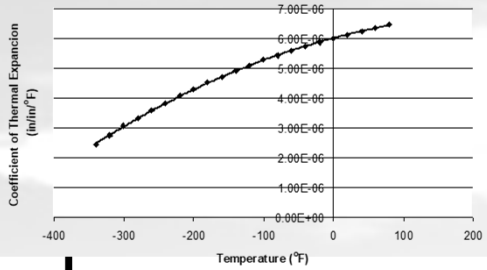


Roll	Number of sheets
1	253
2	250
3	251
4	252
5	253
6	253
7	252
8	254
9	252
10	252

$$P(y \ge 250) = \int_{250}^{\infty} 0.3515\ e^{-0.3881(y-252.2)^2}\,dy$$

Calculating diameter contraction for trunnion-hub problem

$$\Delta D = D\int_{T_{room}}^{T_{fluid}} \alpha dT$$



T	α
80	6.47
60	6.36
40	6.24
20	6.12
0	6.00
-20	5.86
-40	5.2
-60	5.58
-80	5.43
-100	5.28
-120	5.09

T	α
-140	4.91
-160	4.72
-180	4.52
-200	4.30
-220	4.08
-240	3.83
-260	3.58
-280	3.33
-300	3.07
-320	2.76
-340	2.45

TRAPEZOIDAL RULE

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Number of significant digits

The distance covered by a rocket from t=8 to t=34 seconds is calculated using composite trapezoidal rule by integrating a velocity function. Below is given the estimated distance for different number of segments, n.

n	1	2	3	4	5
Value	16520	15421	15212	15138	15104

The number of significant digits at least correct in the answer for n=5 is

1
2
3
4

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A composite trapezoidal rule of integration with 2 segments is exact for integration of polynomials of order of at most

1
2
3
4

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In composite trapezoidal rule, the number of segments needed to get the exact value for a general definite integral

1
2
1 googol
infinite

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In a composite trapezoidal rule with 8 segments, the number of points at which the function is evaluated is

8
9
16
17

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18

In a composite trapezoidal rule with 8 segments, the number of function evaluations is

8
9
16

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The true error in a single application trapezoidal rule of integration is given by

$$E_t = -\frac{(b-a)^3}{12} \times f''(c).$$

The point c is _____

$\frac{a+b}{2}$
between a and b, both included
same as a
same as b

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Error in estimating integral of a function

A student uses the composite trapezoidal rule with 32 segments to calculate an integral. The student then uses the composite trapezoidal rule with 16 segments to calculate the same integral. The true error in the estimate of the integral when using 16 segments would be _____ of true error in the estimate of the integral when using 32 segments.

- exactly quarter
- approximately quarter
- approximately quadruple
- exactly quadruple
- exactly double
- approximately double
- exactly half
- approximately half

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