PShaji_Assignment13

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1. Use integration by substitution to solve the integral below.

$\int 4e^{-7x}dx$

Answer 1)

$z = -7x$

$dx = -17dz$

$4\int e^z - 1/7dz$

$-4/7\int e^z dz$

$-4/7e^z + C$

$-4/7e^{-7x} + C$

2. Biologists are treating a pond contaminated with bacteria. The level of contamination is changing at a rate of $\int dN/dt = -3150/t^4 - 220$ bacteria per cubic centimeter per day, where t is the number of days since treatment began. Find a function N(t) to estimate the level of contamination if the level after 1 day was 6530 bacteria per cubic centimeter.

Answer 2)

$\int dN/dt = \int -3150/t^4 - 220dt$

$= -12600/t^3 - 220t + C$

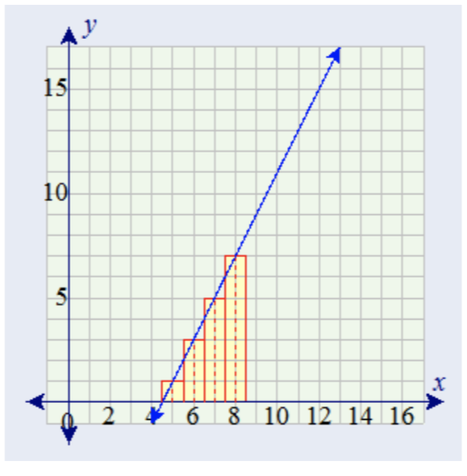
Given, N(1)=6530 we can use this to find C

$N(1) = 6530 = -12600/1^3 - 220(1) + C$

$C = 6290$

$N(1) = -12600/t^3 - 220t + 6290$

3. Find the total area of the red rectangles in the figure below, where the equation of the line is f (x) = 2x - 9



Answer 3)

$\int_{4.5}^{8.5} 2x - 9xdx$

$x^2 - 9xdx|_{4.5}^{8.5}$

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((8.5)*(8.5)-(9*8.5))-((4.5)*(4.5)-(9*4.5))
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## [1] 16
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Therefore, the total area of the red rectangles is 16.

4. Find the area of the region bounded by the graphs of the given equations. $y = x^2 - 2x - 2, y = x + 2$ Enter your answer below.

Answer 4)

To find the intersections:

$x+2=x^2-2x-2

$0 = x2 - 3x - 4$

$0 = (x - 4)(x + 1)$

So the intersections occur at x=−1 and x=4

The area enclosed by these points has y=x+2 above the other equations. So to find the area:

$\int_{-1}^{4} x^2 + 2dx - \int_{-1}^{4} x^2 - 2x - 2dx$

$= \int_{-1}^{4} -x^2 + 3x + 4dx$

$= -x^3/3 + 3x^2/2 + 4x|_{-1}^{4}$

$= -64/3 + 48/2 + 16 - (-1/3 + 3/2 - 4) = -63/3 + 45/2 + 20$

$= -21 + 22.5 + 20$

$= 21.5$

5. A beauty supply store expects to sell 110 flat irons during the next year. It costs $3.75 to store one flat iron for one year. There is a fixed cost of $8.25 for each order. Find the lot size and the number of orders per year that will minimize inventory costs.

Answer 5)

Let x be number of orders/year y be lot size per order

then x * y - total number of irons ordered for the year

x*y >= 110, valid values for x are > = 1 as we need a minimum order of 1 per year to ship the inventory)

Cost of inventory per year = 3.75 (yx - 110) + 8.75x = 3.75yx + 8.75*x - 412.5

Our objective is to keep our cost of inventory per year at the minimum, we need to minimize x and maximize y. From the cost fucntion above, the mimumum value for x is 1 and since y = 110/x, y = 110.

By substitution, minimum cost is -

x is number of orders/year = 1 y is lot size per order = 110

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inventory_cost = 3.75 * ((110)*(1) - 110) + 8.75*(1)
inventory_cost
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## [1] 8.75
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6. Use integration by parts to solve the integral below $\int ln(9x).x^6dx$

6) Answer

We will be using integration by parts methods:

$\int u * dv/dx * dx = u * v - \int v * du/dx * dx$

$u = ln(9x)$

du/dx, using chain rule -

$u = 9xd/du[lnu * d/dx(9x)] = 1/u * d/dx(9X) = 1/9x * 9$

$du/dx = 1/x$

$dv/dx = x^6$

$v = x^7/7$

$= ln(9x) * x^7/7 - \int x^7/7 * 1/x * dx = x^7 * (ln(9x)/7 - 1)$

7. Determine whether f (x) is a probability density function on the interval [1, e6] . If not, determine the value of the definite integral. $f(x) = 1/6x$**

Answer 7)

$\int_1^{e^6} 1/(6x)$

$1/6 * lnx$ from $[1, e^6]$

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prob_density = (1/6) * log(exp(6)) - ((1/6) * log(1))
prob_density
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```
## [1] 1
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f (x) is a probability density function on the interval $[1, e^6]$ - with the area of the curve as 1 (100% probabily for the interval)