



[1] For what values of  $c$  does the function

$$f(x) = \frac{x - 3}{c^2x^2 - cx - 2}$$

have a vertical asymptote at  $x = 1$ ? You must justify your answer.

[1] (20 pts)

Please leave blank!

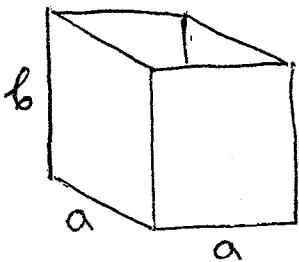
[2] Find the first and second derivatives of  $f(x) = \cos(\sqrt{x})$ .

[2] (20 pts)
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[3] You are building a box without a lid with square base  $a$  and height  $b$ . The box needs to have volume 1. What is the minimum possible surface area of the box? To receive full credit, you must justify carefully why your answer gives the minimum and not the maximum.



[3] (20 pts)

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[4] Solve the initial value problem for the function  $f(x)$

$$f''(x) = 15x^{-2} + 4, \quad f'(1) = 0, \quad f(1) = 1.$$

[4] (20 pts)
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[5] Find the derivative  $f'(x)$ , where

$$f(x) = \int_{2x}^{5x} \sqrt{4t + e^t} dt.$$

If you think you found a formula for  $f(x)$  itself, it means you have made a mistake.

[5] (20 pts)

Please leave blank!

[6] Find the integral

$$\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} (x + \sqrt{\cos x})^2 dx.$$

You must justify your answer.

[6] (20 pts)

Please leave blank!

[7] Find the volume of the solid obtained by rotating the triangle with vertices  $(1, 1)$ ,  $(1, 2)$  and  $(2, 0)$  around the  $y$ -axis.

[7] (20 pts)

Please leave blank!

[8] Find the length of the parametric curve  $(x, y) = (e^t + e^{-t}, 2t)$ ,  $0 \leq t \leq 1$ .  
Hint:  $a^2 + 2ab + b^2 = (a + b)^2$ .

[8] (20 pts)

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[9] Find the integral

$$\int_0^{e-1} \left( \frac{\ln(1+x)}{1+x} \right) dx.$$

[9] (20 pts)
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[10] Find the limits

(a)[10pts]  $\lim_{x \rightarrow +\infty} \left(1 + \frac{x}{\pi}\right)^x$

(b)[10pts]  $\lim_{x \rightarrow +\infty} x\left(\frac{\pi}{2} - \arctan x\right)$ .

[10] (20 pts)
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