






< Previous


















Next >

Problem 3.1

 Bookmark this page

Problem 3.1

3 points possible (ungraded)

Evaluate the integrals (use pi for  $\pi$  ans sqrt(#) for  $\sqrt{\#}$ )

1)  $\int_{-\infty}^{\infty} \frac{x^4}{1+x^6} dx$

2)  $\int_0^{2\pi} \frac{\cos 2\theta}{2+\cos \theta} d\theta$

$\int_{-\infty}^{\infty} \frac{dx}{(x^2+a^2)(x^2+b^2)^2}$  for real  $a, b = \frac{\boxed{\phantom{00}} + 2\boxed{\phantom{00}}}{2|a|\boxed{\phantom{00}}(\boxed{\phantom{00}} + |b|$

$|a|$

$|b|$

$|a|^2$

$|b|^2$

$|a|^3$

$|b|^3$


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You have used 0 of 6 attempts


< Previous


Next >


⏪ Previous


















Next ⏩

Problem 3.2

 Bookmark this page

Problem 3.2

1 point possible (ungraded)

Evaluate residue at  $z = \infty$  of  $f(z) = z^3 \cos \frac{1}{z-2}$ .

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⏪ Previous

Next ⏩

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< Previous

Next >

Problem 3.3

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Homework due Nov 11, 2020 19:00 EST

Problem 3.3

4 points possible (graded)

Evaluate residues of

$$f(z) = \frac{1}{z^3 - z^5}$$

at  $z = -1$ ,  $z = 0$ ,  $z = 1$  and  $z = \infty$ . What is the sum of the residues?

Res <sub>$z=-1$</sub>   $f(z)$

Res <sub>$z=0$</sub>   $f(z)$

Res <sub>$z=1$</sub>   $f(z)$

Res <sub>$z=\infty$</sub>   $f(z)$

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< Previous


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◀ Previous

















Next >

Problem 3.4

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Problem 3.4

1 point possible (ungraded)

Evaluate the integral over the contour  $\mathcal{C}$ , which is a circle of radius 2 centered at  $z = 0$  (use pi for  $\pi$  and i for imaginary unity):

$$\int_{\mathcal{C}} \frac{z^5 dz}{1+z^6}$$

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◀ Previous

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⏪ Previous


















Next ⏩

### Problem 3.5

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### Problem 3.5

1 point possible (ungraded)

Evaluate the integral (use exp for exponential function and pi for  $\pi$ )

$$\int_{-\infty}^{\infty} \frac{\sin^2 x dx}{x^2(x^2+1)}$$


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⏪ Previous

Next ⏩

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< Previous

















Next >

Problem 3.6

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Problem 3.6

2 points possible (ungraded)

Do the limits exist?

$\lim_{R \rightarrow \infty} \int_{C_R} e^{iz} ,$  where  $C_R$  - semicircle of radius  $|z| = R$  in the upper half-plane

☐ yes

☐ no

$\lim_{R \rightarrow \infty} \int_{C_R} e^{iz^2} ,$  where  $C_R$  - the arc  $z = Re^{i\phi}$  with  $0 \leq \phi \leq \pi/4$ ?

☐ yes

☐ no

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< Previous


Next >





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< Previous








Next >

Problem 3.7

 Bookmark this page

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Problem 3.7

2 points possible (graded)

Evaluate the integrals (use pi for  $\pi$  and exp for exponential function).

$$\int_0^\infty \frac{x - \sin x}{x^3} dx$$

$$\int_{-\infty}^\infty \frac{e^{-iz} dz}{z^2 + 9}$$

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< Previous

Next >



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1 point possible (ungraded)  
Evaluate at real  $k$  and  $a$ :

The diagram illustrates the process  $e^+e^- \rightarrow \pi^0 \gamma \gamma$ . It features an incoming electron line (solid) and an incoming positron line (solid) meeting at a vertex. From this vertex, a  $\pi^0$  meson (solid line) and a photon (dashed line) emerge. The photon then splits into two more photons (dashed lines) via a loop diagram.

	$a$	$\text{sign}(a)$	$4$	$2$	$ k  a $	$ka$	
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Next >


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< Previous








Next >

### Problem 3.9

 [Bookmark this page](#)

Homework due Nov 11, 2020 19:00 EST

### Problem 3.9

1 point possible (graded)

Evaluate the integral (use pi for  $\pi$  and exp for exponential function):

$$\int_{-\infty}^{\infty} \frac{\cos\left(x-\frac{1}{x}\right)}{1+x^2} dx$$

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< Previous

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< Previous

Next >

Problem 3.10

Bookmark this page

Problem 3.10

2 points possible (ungraded)  
Evaluate the principal value of the following integrals.

PV  $\int_0^\infty \frac{x^{a-1}}{1-x^b} dx$  for  $b > a > 0$

	$a$	$b$	$\pi$	$2\pi$	$\cot$	$\cos$	
--	-----	-----	-------	--------	--------	--------	--

PV  $\int_0^\infty \frac{x dx}{(x^2+a^2) \sin bx}$  for  $a > 0, b > 0$

	$\pi$	$2$	$a$	$b$	$ab$	$\sin$	
--	-------	-----	-----	-----	------	--------	--

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