

i>Clicker Questions

Phys 101 W2013

- Set your frequency to AC. Hold down the power button til you see blinking. Then hit A, followed by C.
- “Official” standard is i>Clicker2
(but original i>clicker will work for this class)
- After the 1st day I will give out clicker pts. This is a participation grade. To get your clicker point for the day you will need to respond (not necessarily correctly) to *almost* all clicker questions from the given day. (I allow you to miss one question.)
- To receive your clicker pts, you will need to register your i>Clicker at
<http://www.iclicker.com/support/registeryourclicker/>
(Answer “no” to the Learning Management System.)

1/7/13 #1: Test Run

Which best describes your experience with i>Clickers and clicker questions?

- A) I love them
- B) They're OK
- C) I hate them
- D) I've never used them

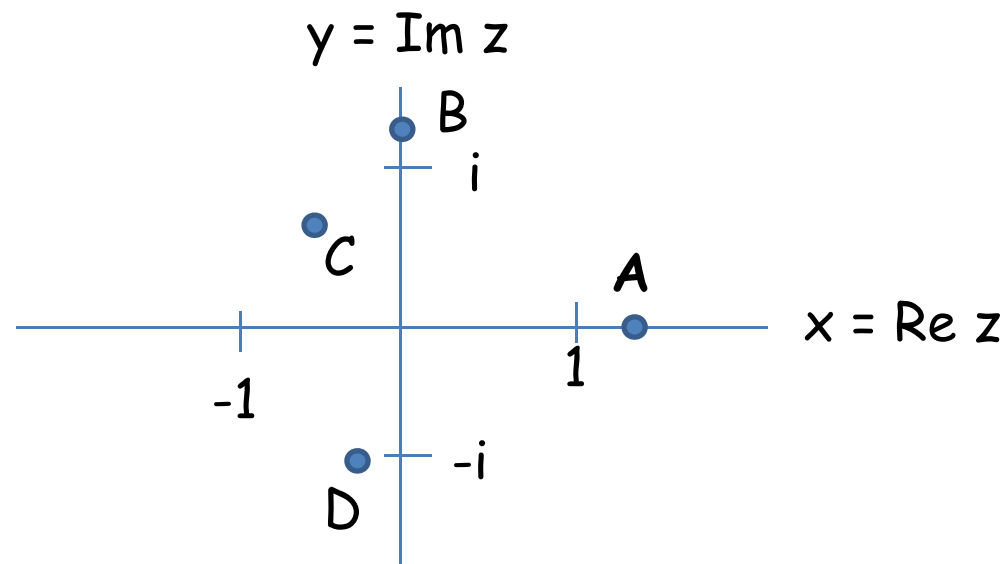
1/7/13 #2

We are using clicker questions because

- A) They help Prof. M monitor your understanding.
- B) They help you learn
- C) Prof. M loves multiple choice questions.
- D) All of the above.

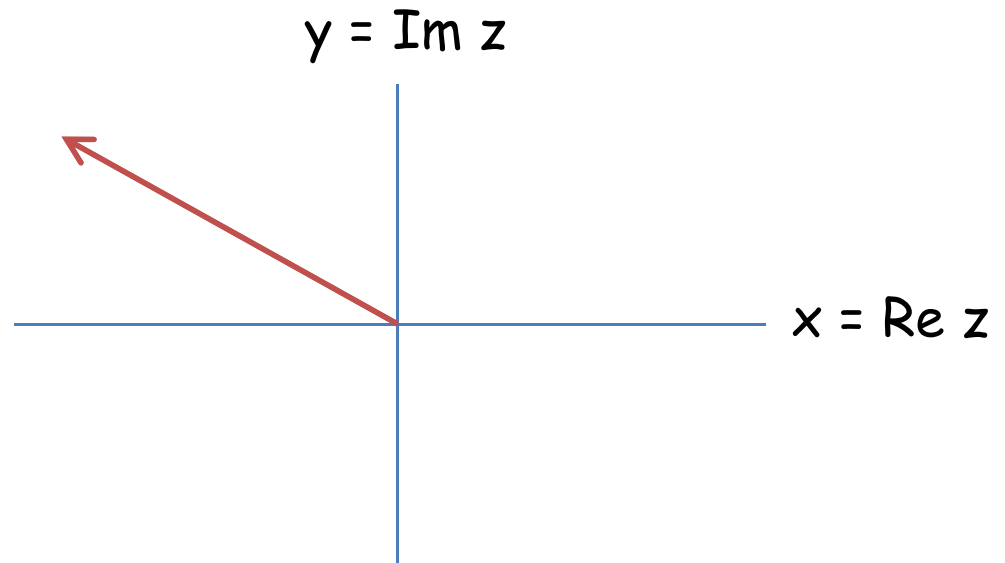
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1/9/13 #1: Wake-up exercise



Which of the above 4 points are closest to $z = \text{Sin}(i)$?

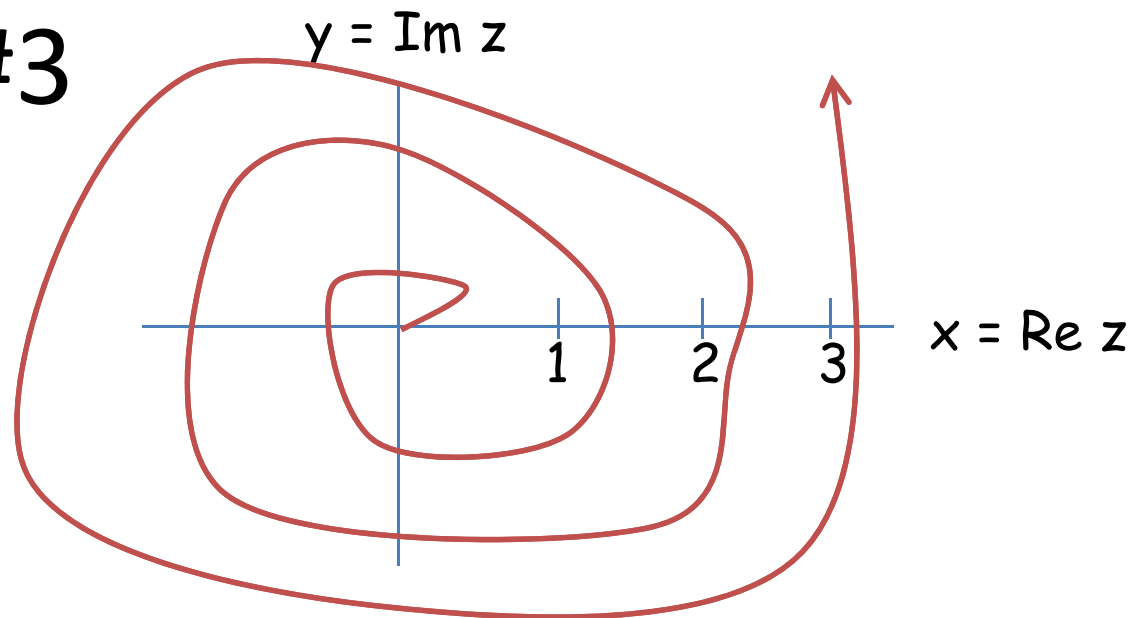
1/9/13 #2



For $f = z^{1/4}$ defined by the above branch cut (red arrow) and $f(1) = 1$, what is $f(-1)$?

- A) $(1+i)/\sqrt{2}$
- B) $-(1+i)/\sqrt{2}$
- C) $(1-i)/\sqrt{2}$
- D) $(-1+i)/\sqrt{2}$

1/9/13 #3



For $f = \ln z$ defined by the above branch cut (red spiral arrow) and $f(1) = 0$, what is $f(e)$?

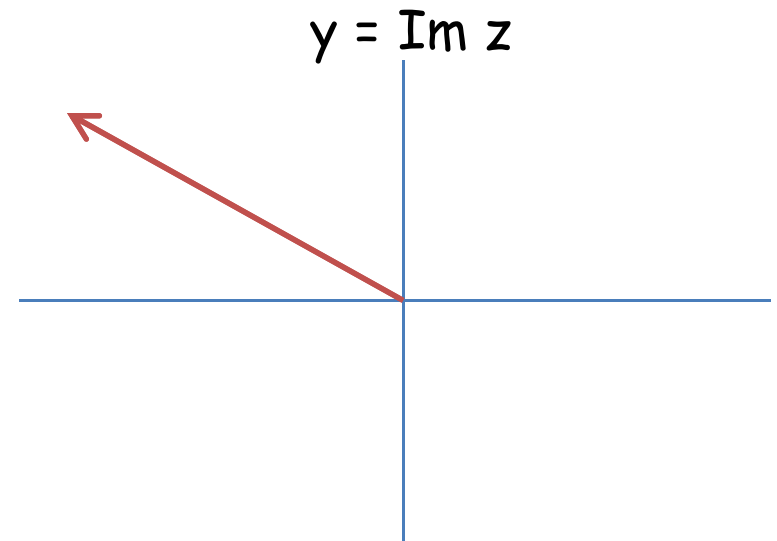
- A) 1
- B) $1 + 2\pi i$
- C) $1 - 2\pi i$
- D) $1 + 4\pi i$

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1/11/13 #1: Wake up exercise

For $f = \log z$ defined by the branch cut (red arrow) as shown and $f(1) = 0$, what is $f(-1)$?

- A) $i\pi$
- B) $-i\pi$
- C) $2i\pi$
- D) $3i\pi$



1/11/13 #2

What are the singular points of $\ln z$ (thought of as a multi-valued function)? (Hint: About which z_0 can we expand $\ln z$ in a power series?)

A) 0

B) $2n\pi i$

C) $e, 1/e$

D) 0 and ∞ .

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1/14/13 #1: Wake-up exercise

Which two of the following functions satisfy the Cauchy-Riemann equations at $z=1$?

$$f(x+iy) = x^2 - y^2 + 2ixy$$

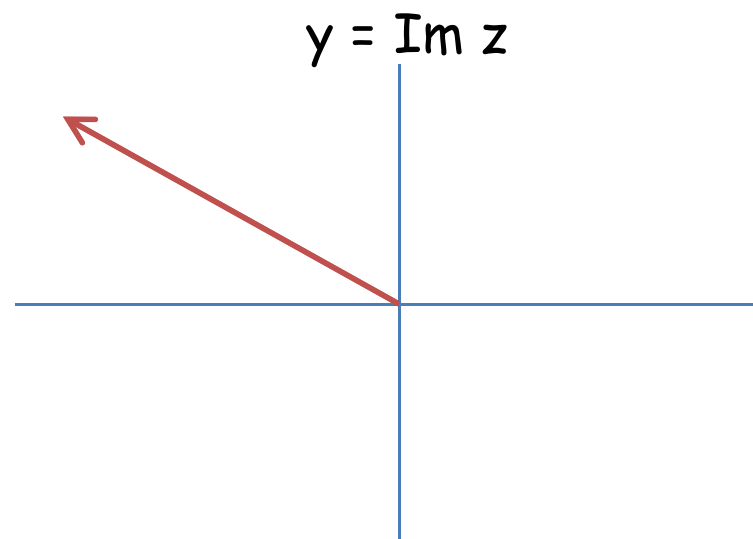
$$g(x+iy) = \cos(x^{24}/y^3)$$

$$h(x+iy) = \ln|x^2+y^2| + 2i \tan^{-1}(y/x)$$

- A) f and g
- B) f and h
- C) g and h
- D) Actually, all 3 are regular at $z=1$.

1/14/13 #2

What are the singular points of the single-valued function defined by $f = \log z$ with the branch cut (red arrow) as shown and $f(1) = 0$?



- A) $2n\pi i$
- B) 0 and ∞
- C) The entire branch cut
- D) e and $1/e$

1/14/13 #3

Let $f(x + iy) = u(x, y) + i v(x, y)$ be an analytic function with real parts u, v . What is

$$\vec{\nabla} u \cdot \vec{\nabla} v ?$$

Hint: Use the Cauchy-Riemann equations

- A) $|\vec{\nabla} u| |\vec{\nabla} v|$
- B) $-|\vec{\nabla} u| |\vec{\nabla} v|$
- C) 0
- D) None of the above

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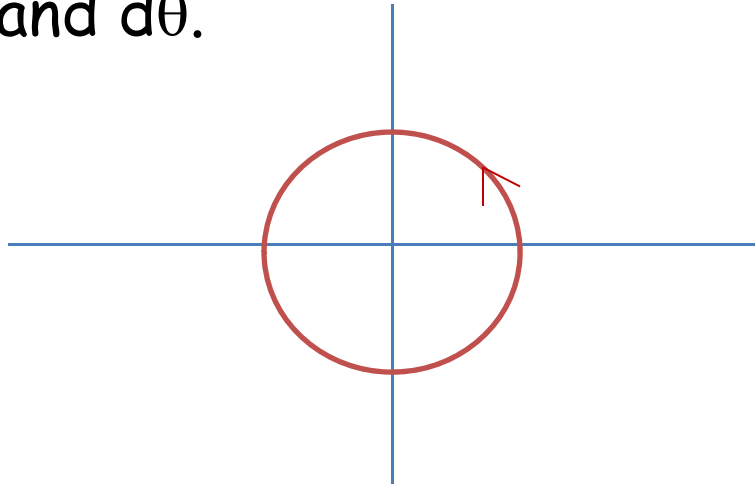
1/16/13 #1: Free clicker-point day

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1/18/13 #1: Wake up excercise

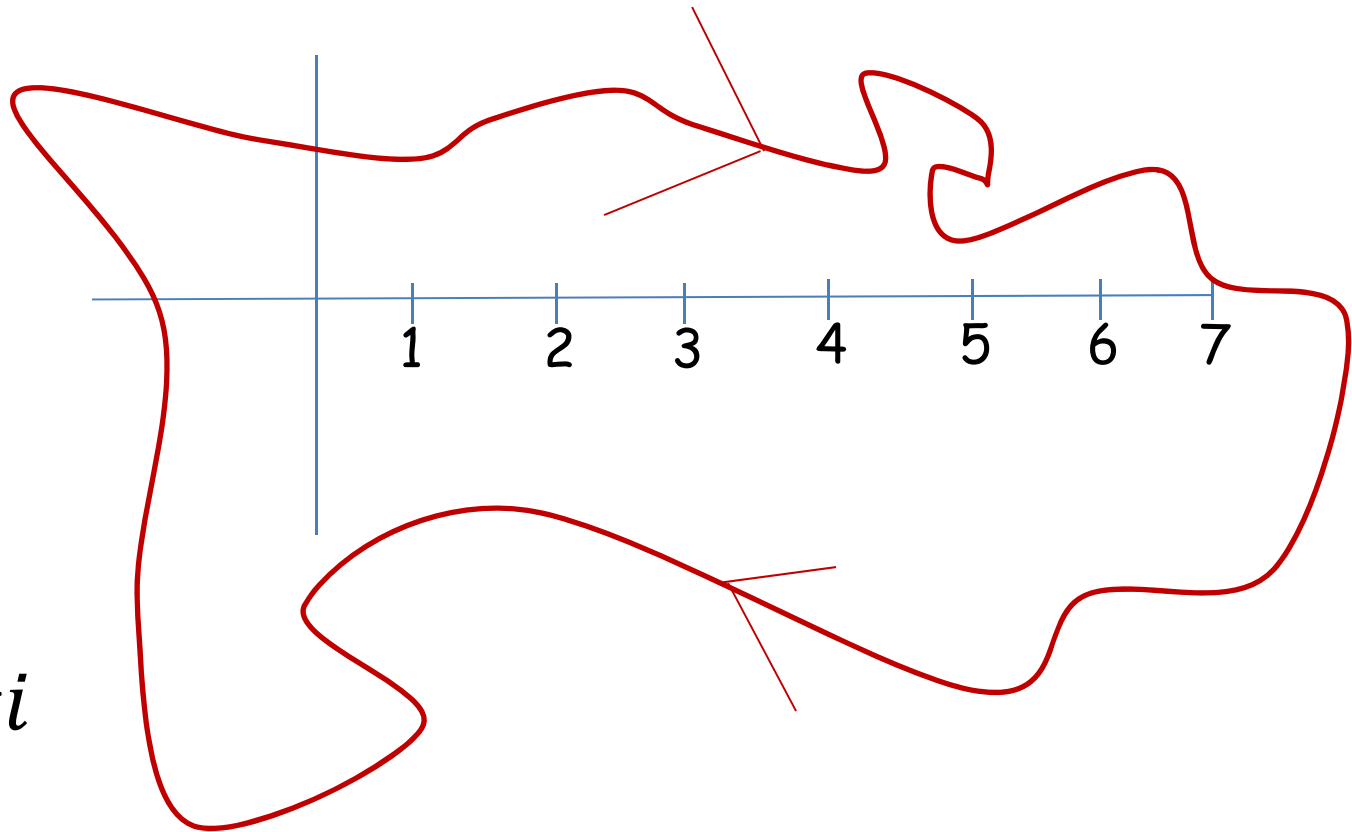
Evaluate $\int_C \frac{dz}{z}$ for the contour C along the unit circle $|z| = 1$, starting at $z=1$ and circling the origin once counter-clockwise. Hint: write z and dz in terms of θ and $d\theta$.



- A) 0
- B) $2\pi i$
- C) $-2\pi i$
- D) 2π

1/18/13 #2

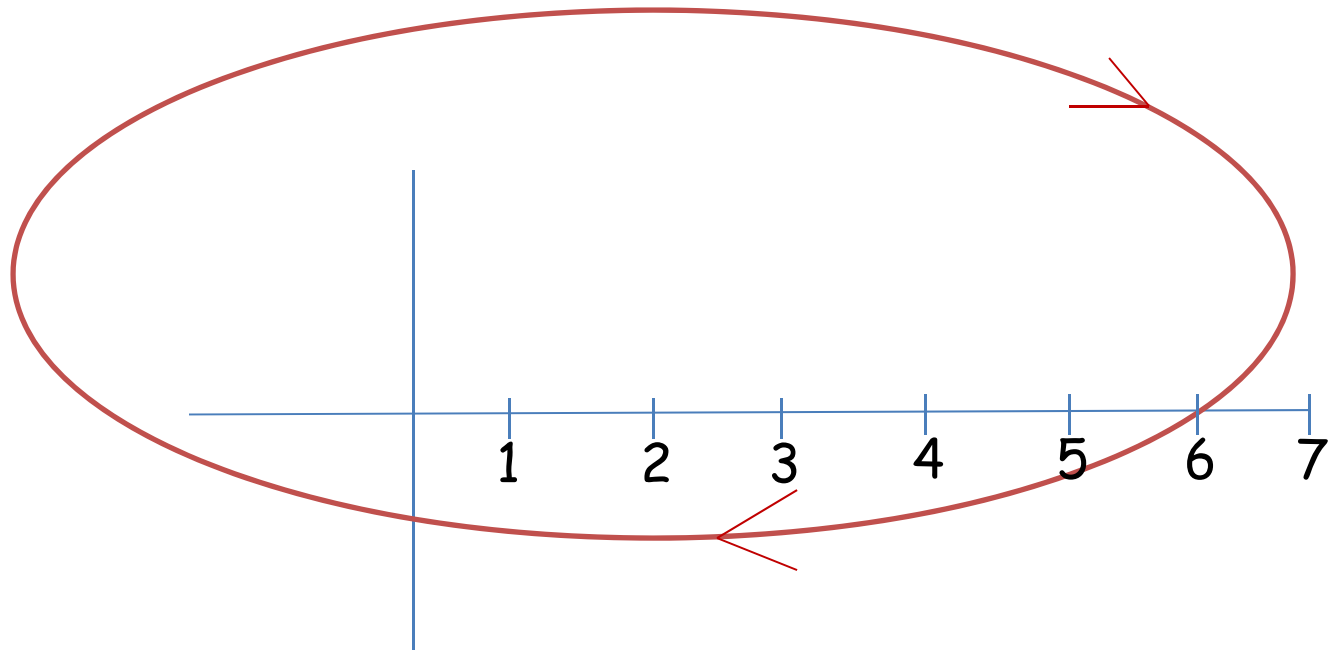
Evaluate $\oint_C \frac{z^3 \cos^4 z}{z - 2\pi} dz$ for the contour shown.



- A) 0
- B) $(2\pi)^4 i$
- C) $(2\pi)^3$
- D) $-(2\pi)^4 i$

1/18/13 #3

Evaluate $\oint_C \frac{z^3 \cos^4 z}{z - 2\pi} dz$ for the contour shown.



- A) 0
- B) $(2\pi)^4 i$
- C) $(2\pi)^3$
- D) $-(2\pi)^4 i$

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1/23/13 #1: Wake up excercise

What is the radius of convergence of the series

$$\frac{1}{1-z} = \sum_{n=0}^{\infty} z^n \quad \text{around } z=0?$$

- A) 1
- B) ∞
- C) 0
- D) 2π

1/23/13 #2: Laurent Series

Find a Laurent series $\sum_{m=0}^{\infty} c_m (z - z_0)^m$ for $f(z) = \frac{1}{z^2+1}$ about $z_0 = i$ that converges near z_0 . What is c_{-1} ?

A) $2i$

B) $-\frac{i}{2}$

C) 0

D) π

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1/25/13 #1: Wake up excercise

What is the residue of $f(z) = \frac{e^z}{z^2-1}$ at $z = 1$?

- A) 1
- B) 1/2
- C) e/2
- D) -1/2

1/25/13 #2:

What is the residue of $f(z) = \frac{e^z}{(z-1)^3}$ at $z = 1$?

- A) e
- B) $e/2$
- C) $e/4$
- D) $e/8$

1/25/13 #3: Laurent Series

Consider the Laurent series $\sum_{m=0}^{\infty} c_m (z - z_0)^m$ for

$f(z) = \frac{1}{(z-1)(z-2)}$ about $z_0 = 0$ that converges for $2 < |z|$.

What is c_{-1} ?

A) $-1/2$

B) 3

C) 0

D) -5

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1/28/13 #2: Wake up exercise

What are the residues of $f(z) = \frac{1}{(z-1)(z+1)}$ at $z = -1$ and $z=1$ (in that order)?

- A) $\frac{1}{2}, \frac{1}{2}$
- B) $\frac{1}{2}, -\frac{1}{2}$
- C) $-\frac{1}{2}, \frac{1}{2}$
- D) $-\frac{1}{2}, -\frac{1}{2}$

1/28/13 #2:

What is the residue of $f(z) = \frac{1}{\sin z}$ at $z = 0$?

- A) 0
- B) 1
- C) 2
- D) 1/2

1/28/13 #3:

What is the residue of $f(z) = \frac{e^z}{(z-1)^3}$ at $z = 1$?

- A) e
- B) $e/2$
- C) $e/4$
- D) $e/8$

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1/30/13 #1: Wake up excercise

What is the residue of

$$f(z) = \frac{z^2+1}{z(z+2)(2z+1)}$$

at $z=-1/2$?

- A) 0
- B) $-5/3$
- C) $-5/6$
- D) ∞

1/30/13 #2:

What is $\int_{-\infty}^{\infty} \frac{1}{1+x^4} dx$?

- A) 0
- B) $\pi/\sqrt{2}$
- C) $-\pi/\sqrt{2}$
- D) $-i/2\sqrt{2}$

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2/1/1 #1: Wake up excercise

What are the residues of $f(z) = \frac{e^{iz}}{z^2+1}$?

- A) $\frac{-e}{2}, \frac{1}{2e}$
- B) $\frac{e}{2}, \frac{-1}{2e}$
- C) $\frac{ei}{2}, \frac{-i}{2e}$
- D) $\frac{-ei}{2}, \frac{i}{2e}$

2/1/13 #2:

What is $\int_{-\infty}^{\infty} \frac{\cos x}{x^2+1} dx$?

- A) $-\pi e$
- B) $\frac{\pi}{e}$
- C) $ie/2$
- D) $-i/2e$

2/1/13 #2:

Consider the integral $\int_{-\infty}^{\infty} \frac{2x+5}{x^2+1} dx$. Can we close the contour without changing the value of the integral?

- A) Yes, in either the upper or lower half-plane.
- B) Yes, but only in the upper half-plane.
- C) Yes, but only in the lower half-plane.
- D) No.

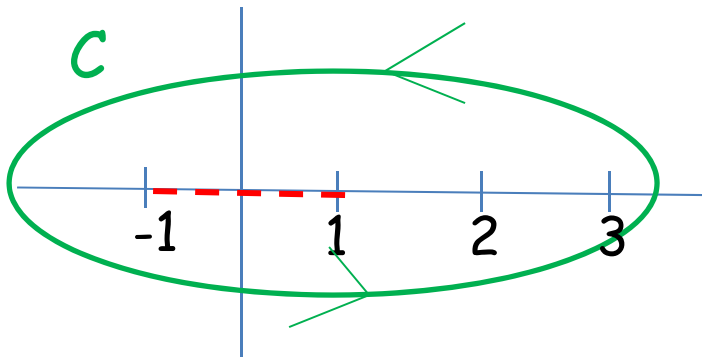
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2/4/13: #1 Wake-up Exercise

Consider the (single-valued!) function $f(z) = \sqrt{1 - z^2}$ defined by taking $f(z) \sim iz$ at large z (as opposed to $f(z) \sim -iz$) and with a branch cut along $[-1,1]$ as shown below.

Evaluate $\oint_C f(z) dz$ for C shown below.

Hint: Find a Laurent series for z (or at least the first few terms) that is valid at large z .



- A) 0
- B) π
- C) 2π
- D) $-\pi$

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2/4/13: #1 Wake-up Exercise

For which real p does the integral

$$\int_{-1}^1 \frac{dx}{x^p}$$

converge absolutely near 0?

- A) $p < 0$
- B) $p \leq 0$
- C) $p < 1$
- D) $p \leq 1$

2/4/13: #2 What is

$$\mathcal{P} \int_{-\infty}^{\infty} \frac{dx}{1-x^3} ?$$

- A) $\pi\sqrt{3}$
- B) $\frac{\pi}{3}\sqrt{3}(1+i)$
- C) $-\frac{\pi}{3}\sqrt{3}$
- D) $\frac{\pi}{3}\sqrt{3}$

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2/8/13 #1: Free clicker-point day

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2/13/13 #1:Wake up question

In 3-dimensional space, consider a uniform infinite sheet of charge located on the surface $y = 0$. What is form of the the resulting electric potential in the region $y > 0$? Below, α is an arbitrary constant.

A) $\varphi = \alpha$

B) $\varphi = \alpha y$

C) $\varphi = \frac{\alpha}{y}$

D) $\varphi = \frac{\alpha}{y^2}$

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2/15/13 #1:Wake up question

What conformal transformations maps the real axis in the z -plane to a right angle in the w -plane?

A) $z = w$

B) $z = \ln w$

C) $z = w^2$

D) $z^2 = w$

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2/20/13 #1:Wake up question

Which of the following matrices can be diagonalized (individually, not simultaneously)?

$$A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}, \quad B = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}, \quad C = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}$$

A) None of the above

B) A only

C) A and B only [Correct answer if we wish to use an orthogonal basis and work with complex numbers.]

D) A, B, and C

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2/22/13 #1:Wake up question

For a real and *negative* compute

$$\frac{1}{2\pi i} PV \int_{-\infty}^{\infty} dx \frac{e^{iax}}{x}$$

- A) 1/2
- B) -1/2
- C) 1
- D) 0

P.S. In case you finish early, the next two questions are identical but with $a > 0$ and $a=0$.

2/22/13 #2

For a real and *positive* compute

$$\frac{1}{2\pi i} PV \int_{-\infty}^{\infty} dx \frac{e^{iax}}{x}$$

- A) 1/2
- B) -1/2
- C) 1
- D) 0

2/22/13 #3

For $a = 0$ compute

$$\frac{1}{2\pi i} PV \int_{-\infty}^{\infty} dx \frac{e^{iax}}{x}$$

- A) $1/2$
- B) $-1/2$
- C) 1
- D) 0

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2/25/13 #1:Wake up question

For real σ , compute

$$\int_{C_1} dz e^{-z^2/\sigma^2} - \int_{C_2} dz e^{-z^2/\sigma^2}$$

Where C_1 is the real axis (traced from $-\infty$ to $+\infty$) and C_2 runs parallel to the real axis (again from $-\infty$ to $+\infty$) but at $\text{Im}z = \alpha$ for some real α .

A) 0

B) 1

C) ∞

D) $2\alpha/\sigma$

2/27/13 #1

For α, t both real and *positive* compute

$$\int_{-\infty}^{\infty} d\omega \frac{e^{-i\omega t}}{(\omega + i\alpha)^2}$$

- A) $2\pi e^{-\alpha t}$
- B) $2\pi t e^{-\alpha t}$
- C) $2\pi e^{\alpha t}$
- D) 0

2/27/13 #2

For α, t both real with $\alpha > 0$ and $t < 0$ compute

$$\int_{-\infty}^{\infty} d\omega \frac{e^{-i\omega t}}{(\omega + i\alpha)^2}$$

- A) $-2\pi e^{-\alpha t}$
- B) $-2\pi t e^{-\alpha t}$
- C) $-2\pi e^{\alpha t}$
- D) 0

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3/1/13 #1:Wake up question

Calculate the residue at $s=3i$ of

$$F(s) = \frac{2s}{(s+3i)(s-3i)} + \frac{s}{(s-3i)^2(s-3i)^2}$$

- A) $e^{3it} \left(1 - \frac{1}{36} - it/12\right)$
- B) $e^{3it} (1 - it/12)$
- C) e^{3it}
- D) 0

Reminder: Set your i>Clicker frequency to AC. Hold down the power button til you see blinking. Then hit A, followed by C. i>Clicker2's will remember this when the power is off, but for i>Clicker1 the frequency has to be reset whenever you turn it on.

3/6/13 #1:Wake up question

Let C be the the imaginary axis of the complex s -plane (i.e., with with $\text{Re } s = 0$), pointing upward as usual. For t real and positive compute

$$\frac{1}{2\pi i} \int_C ds \frac{e^{st}}{(s+1)(s+2)}$$

A) 0

B) $e^{-t} - e^{-2t}$

C) $e^{-t} + e^{-2t}$

D) $-e^{-t} + e^{-2t}$

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3/11/13 #1:Wake up question

What is the Taylor series expansion of $\ln(1+x)$?

- A) $1 - x + x^2 - x^3 + \dots$
- B) $x - x^2/2 + x^3/3 + \dots$
- C) $x + x^2/2 + x^3/3 + \dots$
- D) $x + x^2 + x^3 + \dots$

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