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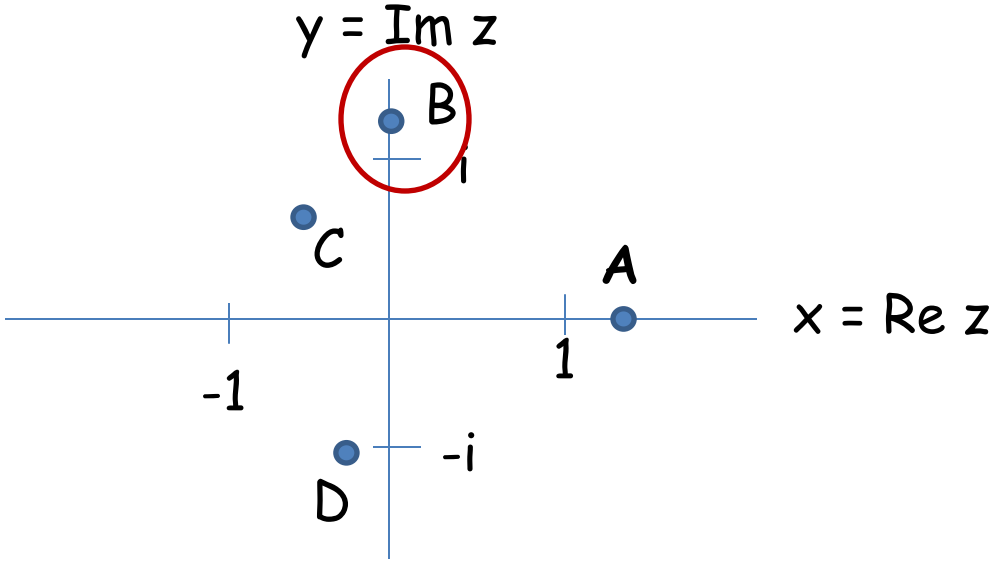
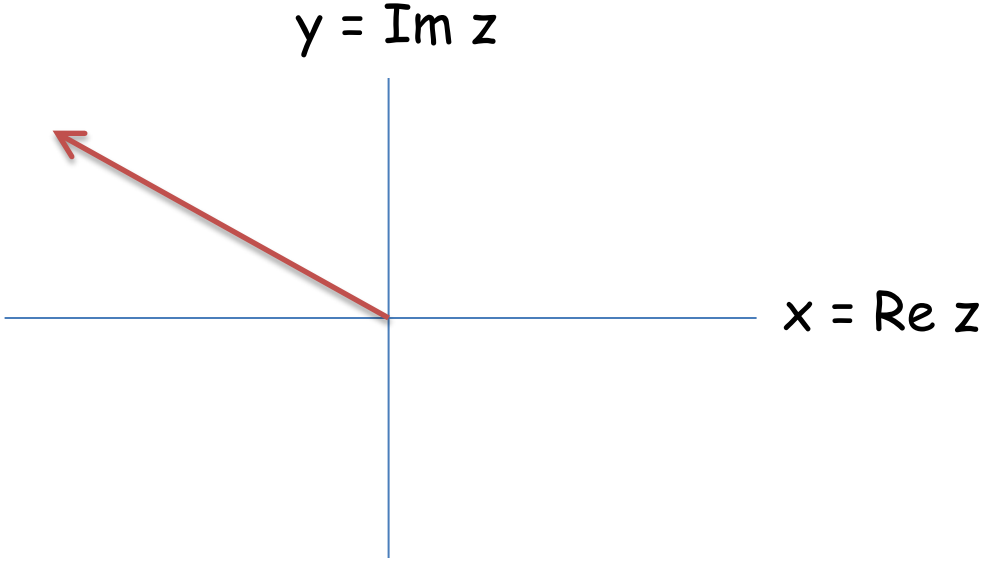
1/9/13 #1: Wake-up exercise



Which of the above 4 points are closest to z= Sin(i)?

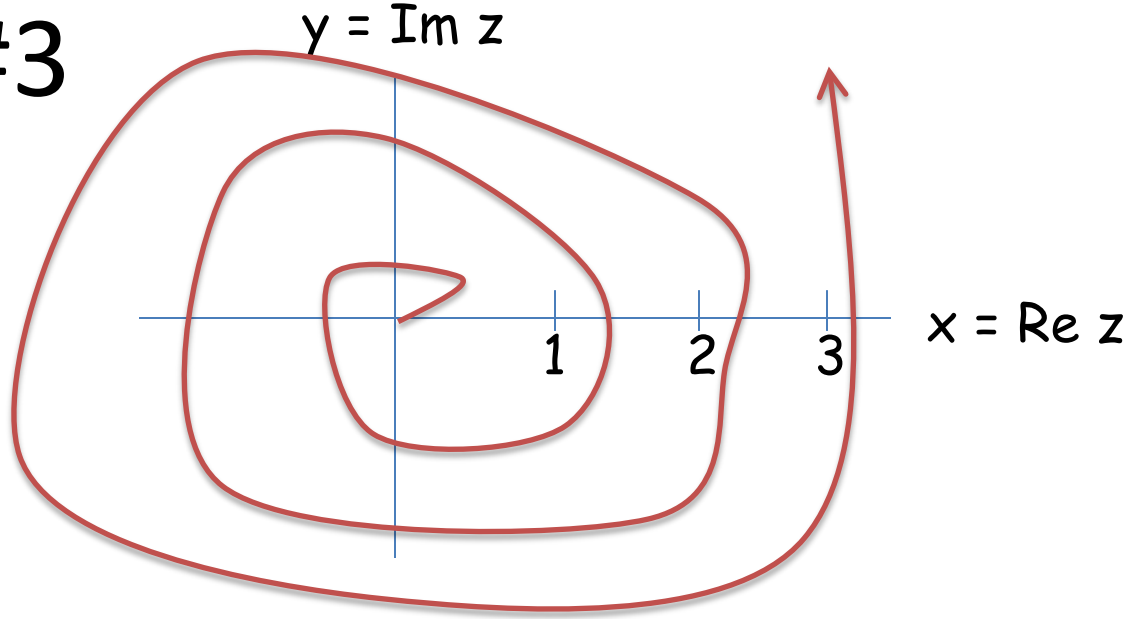
1/9/13 #2



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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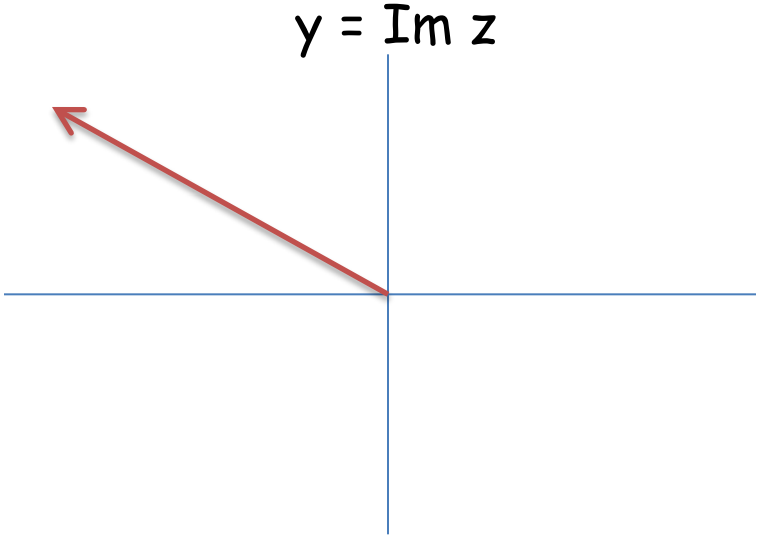
1/11/13 #1: Wake up excercise

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

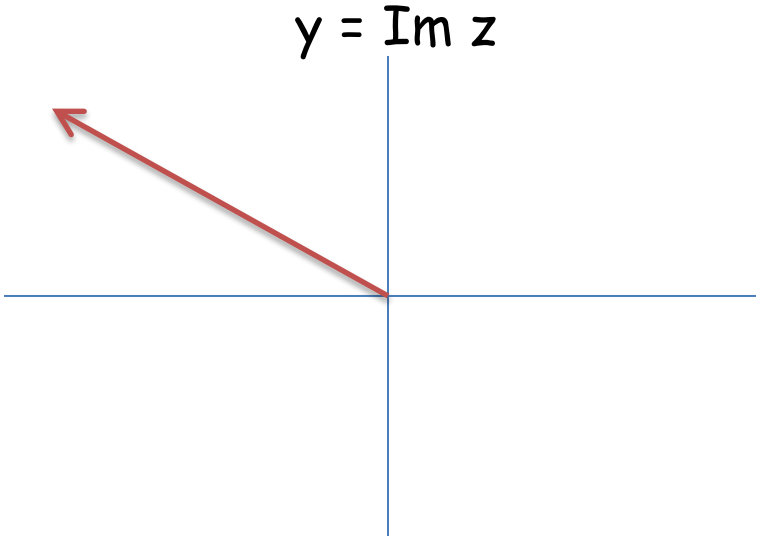
B) f and h

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 amd 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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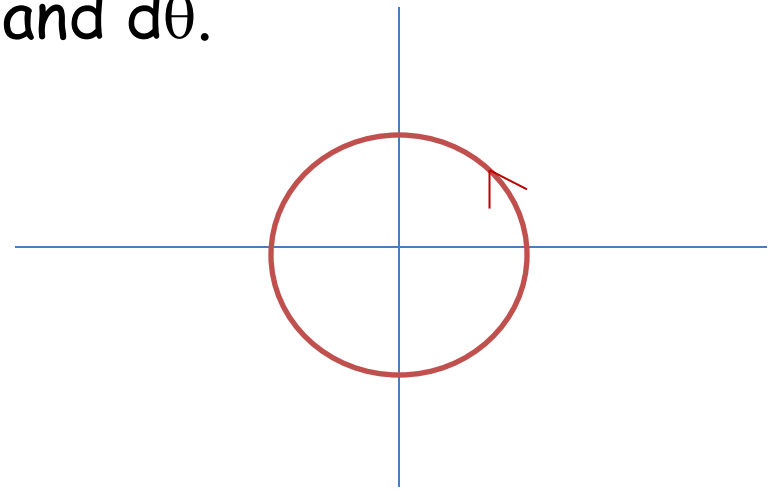
1/18/13 #1: Wake up excercise

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

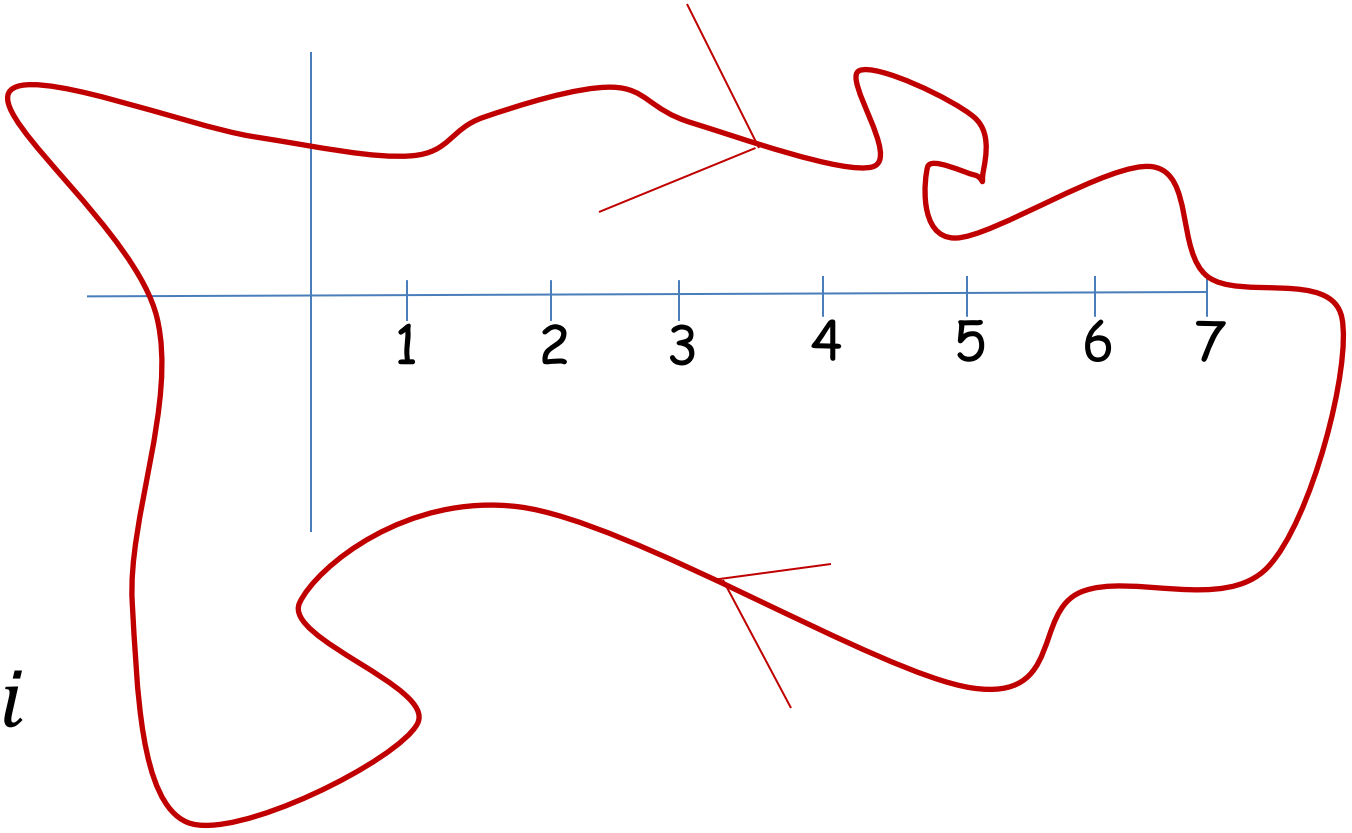
B) $2\pi i$

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

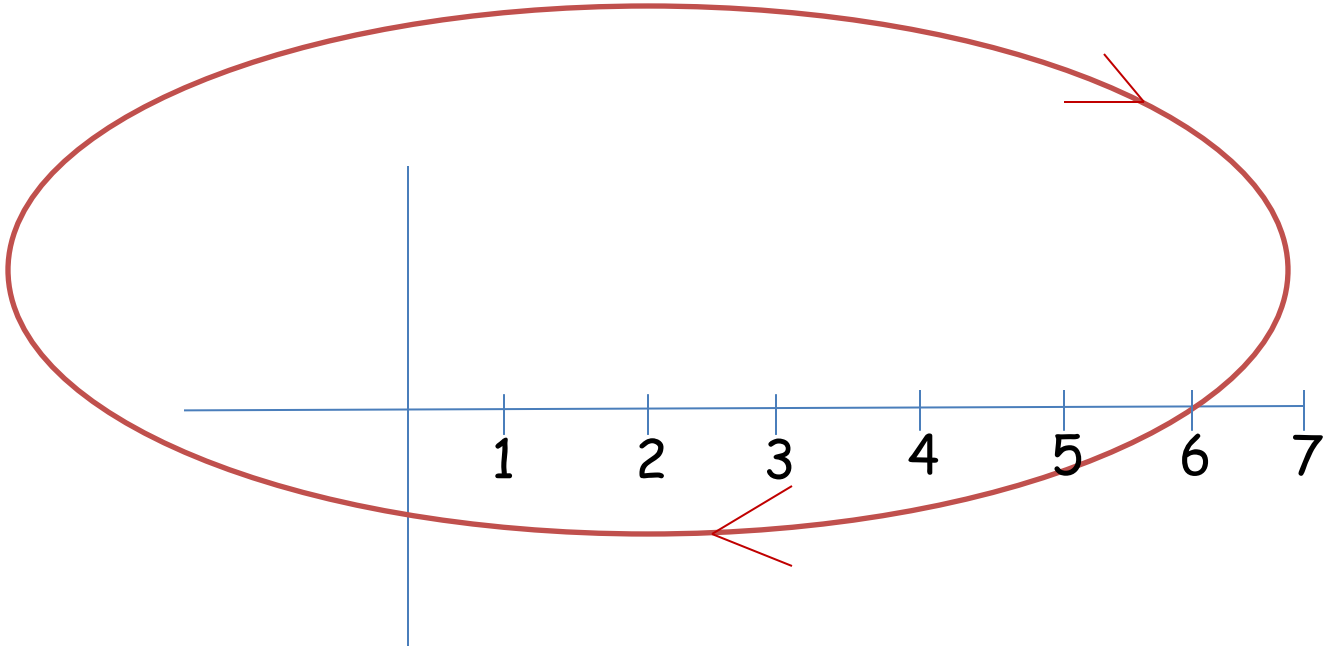
B) $(2\pi)^4 i$

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 $\frac{1}{1-z} = \sum_{n=0}^{\infty} z^n$ 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 $f(z) = \dfrac{e^{iz}}{z^2+1}$?

A) $\dfrac{-e}{2}, \dfrac{1}{2e}$

B) $\dfrac{e}{2}, \dfrac{-1}{2e}$

C) $\dfrac{ei}{2}, \dfrac{-i}{2e}$

D) $\dfrac{-ei}{2}, \dfrac{i}{2e}$

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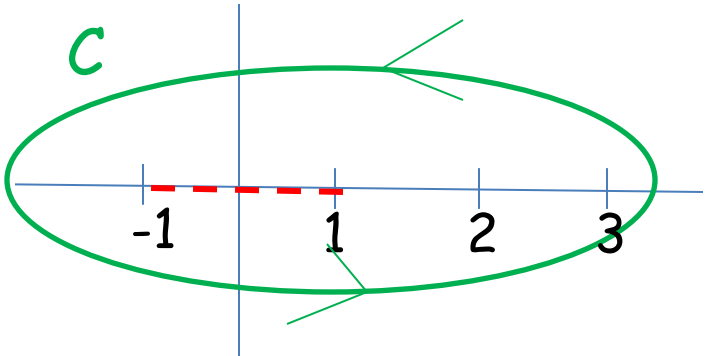
2/4/13: #1 Wake-up Exercise

Consider the (single-valued!) function $f(z) = \sqrt{1-z^2}$ defined by taking f(z) ~ iz at large z (as opposed to f(z) ~ -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) $\frac{\pi}{3}\sqrt{3}$

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.

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.

$A)\ \varphi = \alpha$

$B)\ \varphi = \alpha y$

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

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

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.

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)?

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

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 Imz = α for some real α.

A) 0 B) 1 C) ∞ D) 2 α/σ

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

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.

3/1/13 #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) $e^{3it}(1 - \frac{1}{36} - it/12)$

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

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.

3/8/13 #1: Free clicker-point day

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3/11/13 #1:Wake up question

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

A) $1 - x + x^2 - x^3 + \ldots$

B) $x - x^2/2 + x^3/3 + \ldots$

C) $x + x^2/2 + x^3/3 + \ldots$

D) $x + x^2 + x^3 + \ldots$

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.

3/13/13 #1: Free clicker-point day

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