

# 5.2 The Exponential Function $y=e^x$ Solutions.

6.  $e^3 < 27$  - true because  $e < 3$

8.  $e^0 = 1$  - true - any number raised to zero power is 1.

10a  $\pi \approx \frac{355}{113}$   $\pi \approx 3.141592654\dots$   $\frac{355}{113} \approx 3.14159292$  agree to 6 decimal places.

b)  $e \approx \frac{878}{323}$   $e \approx 2.718281828\dots$   $\frac{878}{323} \approx 2.718266254$  agree to 4 decimal places.

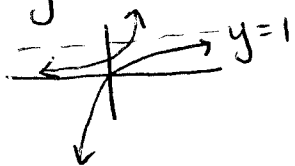
12.  $y=e^{-x}$  D:  $\mathbb{R}$  HA  $y=0$   
R:  $y > 0$   $y$ -int  $(0,1)$

14.  $y=-e^{-x}$  D:  $\mathbb{R}$  HA  $y=0$   
R:  $y < 0$   $y$ -int  $(0,-1)$

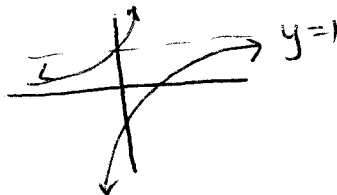
16.  $y=e^{x+1}$  D:  $\mathbb{R}$  HA  $y=0$   
R:  $y > 0$   $y$ -int  $(0,e)$   
Shift to left

20.  $y=e^{-x}-e$  D:  $\mathbb{R}$   
R:  $y > -e$   
HA  $y=-e$   
 $y$ -int  $(0,-e+1)$   
Shift down

22a)  $y=1-e^{-x}$  - reflection across both axes & shifted up one



b)  $y=1-e^{-x+1}$   
Shift to left  
reflect across both axis, up one



24.  $f(x)=x^2$   $g(x)=2^x$   $h(x)=e^x$  on interval  $[9,10]$   
 $f(9)=81$   $f(10)=100$   $g(9)=512$   $g(10)=1024$   $h(9) \approx 8103.083928$   $h(10) \approx 2026.46579$   
AROC = 19      AROC = 512      AROC  $\approx 13923.38187$

a)  $\frac{512}{19} = 26.9$  which is more than 25 times

b)  $\frac{13923.38187}{19} \approx 732.8$  which is near 733 times.

26. a)  $y=2^x$  has slope at  $(0,1)$  of  $\approx 0.7$  and  $y=3^x$  has slope  $\approx 1.1$   
So since  $2 < e < 3$  it makes sense that slope at  $(0,1)$  is 1  $\Rightarrow$  equation

b)  $y=x+1$  around  $x=0$  graphs are very close

$x$	-0.04	-0.03	-0.02	-0.01	0.00	0.01	0.02	0.03	0.04
$x+1$	.96	.97	.98	.99	1	1.01	1.02	1.03	1.04
$e^x$	.96079	.97045	.9802	.99005	1	1.01005	1.0202	1.0305	1.0408
$e^x - (x+1)$	.00079	.00045	.0002	.00005	0	.00005	.0002	.0005	.0008

28.  $g(x) = x^3$  at  $x=1$

Interval	$\Delta g/\Delta x$ for $g(x)=x^3$	Interval	$\Delta g/\Delta x$
$[1, 1.1]$	3.31	$[.9, 1]$	2.71
$[1, 1.01]$	3.0301	$[.99, 1]$	2.97
$[1, 1.001]$	3.003001	$[.999, 1]$	2.997
$[1, 1.0001]$	3.00030001	$[.9999, 1]$	2.9997
$[1, 1.00001]$	3.00003	$[.99999, 1]$	2.99997

So it appears as though the instantaneous ROC at  $x=1$  is 3

32. a AROC  $4 \leq t \leq 6 = \frac{e^6 - e^4}{2} = 174$  bacteria/hour

36.  $y = e^{-x}$  B. Decreasing D. 1-1 E, G

40.  $y = x^2 + e$  C, F, G

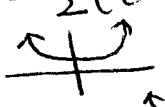
41.  $y = \frac{x}{e}$  A, D, F, G, H

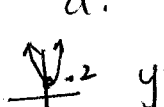
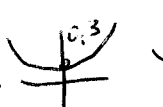
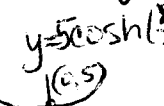
42.  $y = \frac{e}{x}$  D, E

49.  $\frac{1}{\sqrt{e}} = e^{-1/2}$  graph  $\approx .6$  calculator .60653

55. a)  $\cosh 0 = \frac{1}{2}(e^0 + e^{-0}) = \frac{1}{2}(2) = 1$   $\cosh(1) = 1.54$   $\cosh(-1) = 1.54$

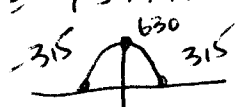
b) domain:  $\mathbb{R}$  c)  $\cosh(-x) = \frac{1}{2}(e^{-x} + e^x) = \cosh(x)$  so  $\cosh x = y$

is an even function d. 

56. a.  $y = .2 \cosh(\frac{x}{.2})$    $y = \cosh x$    $y = 3 \cosh \frac{x}{3}$    $y = 5 \cosh(\frac{x}{5})$

b. as the value of a gets bigger, the graph gets wider and the vertical intercept is  $(0, a)$

c.  $y = 757.71 - 127.71 \cosh(\frac{x}{127.71})$  height is 630 feet and the width is 630 ft.



57a  $\sinh(0) = \frac{1}{2}(e^0 - e^{-0}) = 0$   $\sinh(1) = \frac{1}{2}(e^1 - e^{-1}) \approx 1.18$

$\sinh(-1) \approx -1.18$  b. Domain is all reals

c)  $\sinh(-x) = \frac{1}{2}(e^{-x} - e^{-(-x)}) = \frac{1}{2}(e^{-x} - e^x) = -\frac{1}{2}(e^x - e^{-x})$

$= -\sinh(x)$  so this is an odd function.

