Name: _____ Date: _____ Period: _____ 2016

AP Calculus 2016 – 2017 :: Summer Assignment – **Minimum of 3 decimal places for numeric answers**

Questions 1 – 6: Use the difference quotient $\frac{f(x+\Delta x)-f(x)}{\Delta x}$ to compute the slope from the given function, x, and Δx. Show the setup with x and Δx plugged in, then you may use your calculator to reduce.

1. $f(x)=3x+2, \quad x=2, \quad \Delta x=0.5$ 1. _____

2. $f(x)=-4x^2+2, \quad x=4, \quad \Delta x=0.01$ 2. _____

3. $f(x)=\sin\left(\frac{x}{2}\right), \quad x=\pi, \quad \Delta x=0.5$ 3. _____

4. $f(x)=\frac{x+1}{x-3}, \quad x=2, \quad \Delta x=-0.25$ 4. _____

5. $f(x)=\frac{\sqrt{x}+2}{\sqrt{3-x}}, \quad x=1, \quad \Delta x=0.21$ 5. _____

6. $f(x)=\ln\left(\frac{3}{2x}\right), \quad x=\frac{2}{5}, \quad \Delta x=\frac{1}{10}$ 6. _____

Questions 7 – 14: Given the following functions, find **(a)** the function value and **(b)** the requested composite function simplified.

7. $f(x)=\frac{4}{5}x+6$, $f(10)$, $f(10+h)=$

7. (a) _____

(b) _____

8. $f(x)=-2x^2+4x-5$, $f(2)$, $f(2+h)=$

8. (a) _____

(b) _____

9. $f(x)=\sqrt{7+4x}$, $f(-1)$, $f(h-1)=$

9. (a) _____

(b) _____

10. $f(x)=e^x+4$, $f(3)$, $f(3+h)=$

10. (a) _____

(b) _____

11. $f(x)=\cos x$, $f\left(\frac{\pi}{3}\right)$, $f\left(\frac{\pi}{3}+h\right)=$

11. (a) _____

(b) _____

12. $f(x)=\cos x$, $f\left(-\frac{\pi}{4}\right)$, $f\left(-\frac{\pi}{4}+h\right)=$

12. (a) _____

(b) _____

13. $f(x)=\sin x$, $f\left(\frac{\pi}{3}\right)$, $f\left(\frac{\pi}{3}+h\right)=$ 13. (a) _____

(b) _____

14. $f(x)=\sin x$, $f\left(-\frac{\pi}{4}\right)$, $f\left(-\frac{\pi}{4}+h\right)=$ 14. (a) _____

(b) _____

Questions 15 – 22: Use your answers from questions 7 – 14 to complete/compute the difference quotient.

15. Question 7: $\frac{f(10+h)-f(10)}{h}=$ 15. _____

16. Question 8: $\frac{f(2+h)-f(2)}{h}=$ 16. _____

17. Question 9: $\frac{f(h-1)-f(-1)}{h}=$ 17. _____
(hint: conjugate the numerator)

18. Question 10: $\dfrac{f(3+h)-f(3)}{h}=$ 18. _____

(hint: factor out e^3)

19. Question 11: $\dfrac{f\left(\frac{\pi}{3}+h\right)-f\left(\frac{\pi}{3}\right)}{h}=$ 19. _____

(hint: trig sum rule

get $\dfrac{\cos h-1}{h}$ and $\dfrac{\sin h}{h}$

20. Question 12: $\dfrac{f\left(-\frac{\pi}{4}+h\right)-f\left(-\frac{\pi}{4}\right)}{h}=$ 20. _____

(hint: trig diff rule

get $\dfrac{\cos h-1}{h}$ and $\dfrac{\sin h}{h}$

21. Question 13: $\dfrac{f\left(\frac{\pi}{3}+h\right)-f\left(\frac{\pi}{3}\right)}{h}=$ 21. _____

(hint: trig sum rule

get $\dfrac{\cos h-1}{h}$ and $\dfrac{\sin h}{h}$

22. Question 14: $\dfrac{f\left(-\frac{\pi}{4}+h\right)-f\left(-\frac{\pi}{4}\right)}{h}=$ 22. _____

(hint: trig diff rule

get $\dfrac{\cos h-1}{h}$ and $\dfrac{\sin h}{h}$

Questions 23 – 26: Use the difference quotient $\frac{f(x+h)-f(x)}{h}$ to compute a formula in terms of h given $f(x)$ and x. Make sure the original single h in the denominator gets canceled out.

23. $f(x)=2x^2+3, \quad x=1$ 23. _____

24. $f(x)=4x^3-6, \quad x=2$ 24. _____

25. $f(x)=\sqrt{x}, \quad x=4$ (hint: conjugate) 25. _____

26. $f(x)=\frac{1}{\sqrt{6-x}}, \quad x=-3$ (hint: common denom., then conjugate) 26. _____

Questions 27 – 30: Use the difference quotient $\frac{f(x+h)-f(x)}{h}$ to **(a)** compute a formula in terms of h and x given $f(x)$ and **(b)** then substitute 0 into h to compute a formula only in terms of x. Make sure the original single h in the denominator gets canceled out. **Show all work!**

27. $f(x)=(2x+3)(3x-4)$ 27. (a) _____

(b) _____

28. $f(x)=\frac{1}{x}$ (hint: common denominator) 28. (a) _____

(b) _____

29. $f(x)=\dfrac{x-1}{x+1}$ (hint: common denominator)

29. (a) _____

(b) _____

30. $f(x)=\sqrt{x^2+1}$ (hint: conjugate numerator)

30. (a) _____

(b) _____

Questions 31 – 34: Write the equation of the line in **point-slope** form, from the given slope and point.

31. $m=\frac{3}{5}$ and $p=(2,-4)$ 31. _____

32. $m=-\frac{7}{3}$ and $p=(5,8)$ 32. _____

33. $m=\frac{3}{e}$ and $p=(\ln 4, e^3)$ 33. _____

34. $m=\frac{9}{\ln 2}$ and $p=(-2,1)$ 34. _____

Questions 35 – 40: A graphing calculator is required. Use the steps below to compute the equations of the tangent line and **normal** (perpendicular slope) line in **point-slope** form, from the slope and point you find.

Step 1: Type your function into Y1.
Step 2: Press Trace to evaluate the function at the given x value and record it below.
Step 3: Press 2nd then Trace (CALC) and choose option 6 (dy/dx or slope).
Step 4: Type in the given x value to obtain your slope for your line and record it below.

35. $f(x)=2x^3-3x+5$, $x=2$ tangent: _____

normal: _____

36. $f(x)=\sqrt{3x^2-4x}$, $x=2$ tangent: _____

normal: _____

37. $f(x)=\frac{3-x}{x^2+1}$, $x=4$ tangent: _____

normal: _____

38. $f(x)=\tan x$, $x=\frac{\pi}{6}$ tangent: _____

normal: _____

39. $f(x)=\ln(5x^3-4x^2+6)$, $x=1$ tangent: _____

normal: _____

40. $f(x)=-4.9x^2+\cos x-e^{3x}$, $x=0$ tangent: _____

normal: _____

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FORMULAS FROM GEOMETRY

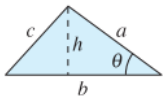
Triangle

$h = a \sin \theta$

$\text{Area} = \frac{1}{2}bh$

(Law of Cosines)

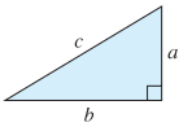
$c^2 = a^2 + b^2 - 2ab \cos \theta$



Right Triangle

(Pythagorean Theorem)

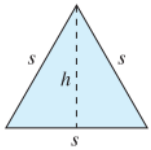
$c^2 = a^2 + b^2$



Equilateral Triangle

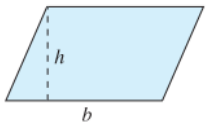
$h = \frac{\sqrt{3}s}{2}$

$\text{Area} = \frac{\sqrt{3}s^2}{4}$



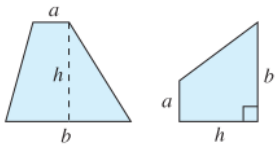
Parallelogram

$\text{Area} = bh$



Trapezoid

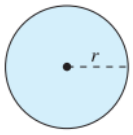
$\text{Area} = \frac{h}{2}(a + b)$



Circle

$\text{Area} = \pi r^2$

$\text{Circumference} = 2\pi r$

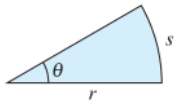


Sector of Circle

(θ in radians)

$\text{Area} = \frac{\theta r^2}{2}$

$s = r\theta$

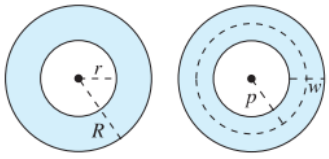


Circular Ring

(p = average radius,
w = width of ring)

$\text{Area} = \pi(R^2 - r^2)$

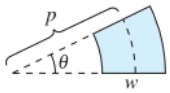
$= 2\pi pw$



Sector of Circular Ring

(p = average radius,
w = width of ring,
θ in radians)

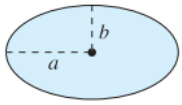
$\text{Area} = \theta pw$



Ellipse

$\text{Area} = \pi ab$

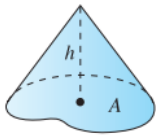
$\text{Circumference} \approx 2\pi\sqrt{\frac{a^2 + b^2}{2}}$



Cone

(A = area of base)

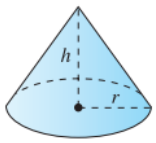
$\text{Volume} = \frac{Ah}{3}$



Right Circular Cone

$\text{Volume} = \frac{\pi r^2 h}{3}$

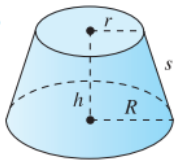
$\text{Lateral Surface Area} = \pi r\sqrt{r^2 + h^2}$



Frustum of Right Circular Cone

$\text{Volume} = \frac{\pi(r^2 + rR + R^2)h}{3}$

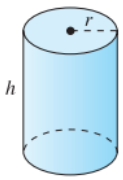
$\text{Lateral Surface Area} = \pi s(R + r)$



Right Circular Cylinder

$\text{Volume} = \pi r^2 h$

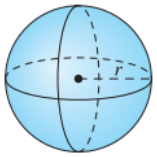
$\text{Lateral Surface Area} = 2\pi rh$



Sphere

$\text{Volume} = \frac{4}{3}\pi r^3$

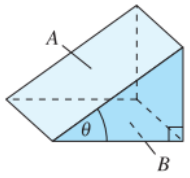
$\text{Surface Area} = 4\pi r^2$



Wedge

(A = area of upper face,
B = area of base)

$A = B \sec \theta$



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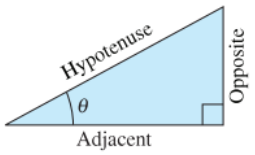
TRIGONOMETRY

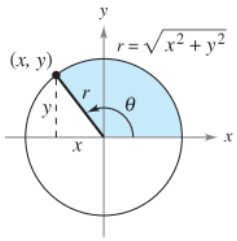
Definition of the Six Trigonometric Functions

Right triangle definitions, where $0 < \theta < \pi/2$.

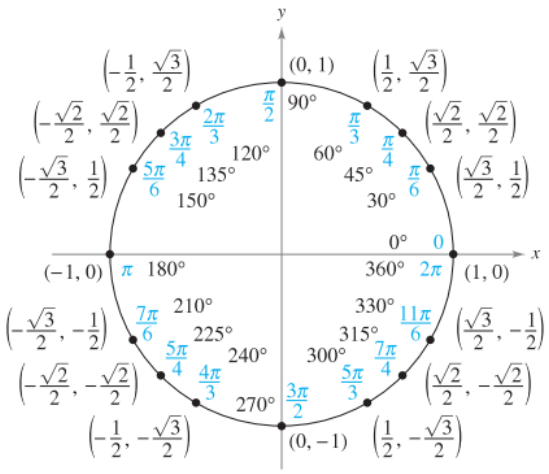


$$\sin\theta = \frac{\text{opp}}{\text{hyp}} \quad \csc\theta = \frac{\text{hyp}}{\text{opp}}$$
$$\cos\theta = \frac{\text{adj}}{\text{hyp}} \quad \sec\theta = \frac{\text{hyp}}{\text{adj}}$$
$$\tan\theta = \frac{\text{opp}}{\text{adj}} \quad \cot\theta = \frac{\text{adj}}{\text{opp}}$$

Circular function definitions, where θ is any angle.



$$\sin\theta = \frac{y}{r} \quad \csc\theta = \frac{r}{y}$$
$$\cos\theta = \frac{x}{r} \quad \sec\theta = \frac{r}{x}$$
$$\tan\theta = \frac{y}{x} \quad \cot\theta = \frac{x}{y}$$



Reciprocal Identities

$$\sin x = \frac{1}{\csc x} \quad \sec x = \frac{1}{\cos x} \quad \tan x = \frac{1}{\cot x}$$
$$\csc x = \frac{1}{\sin x} \quad \cos x = \frac{1}{\sec x} \quad \cot x = \frac{1}{\tan x}$$

Tangent and Cotangent Identities

$$\tan x = \frac{\sin x}{\cos x} \quad \cot x = \frac{\cos x}{\sin x}$$

Pythagorean Identities

$$\sin^2 x + \cos^2 x = 1$$
$$1 + \tan^2 x = \sec^2 x \qquad 1 + \cot^2 x = \csc^2 x$$

Cofunction Identities

$$\sin\left(\frac{\pi}{2} - x\right) = \cos x \quad \cos\left(\frac{\pi}{2} - x\right) = \sin x$$
$$\csc\left(\frac{\pi}{2} - x\right) = \sec x \quad \tan\left(\frac{\pi}{2} - x\right) = \cot x$$
$$\sec\left(\frac{\pi}{2} - x\right) = \csc x \quad \cot\left(\frac{\pi}{2} - x\right) = \tan x$$

Reduction Formulas

$$\sin(-x) = -\sin x \quad \cos(-x) = \cos x$$
$$\csc(-x) = -\csc x \quad \tan(-x) = -\tan x$$
$$\sec(-x) = \sec x \quad \cot(-x) = -\cot x$$

Sum and Difference Formulas

$$\sin(u \pm v) = \sin u \cos v \pm \cos u \sin v$$
$$\cos(u \pm v) = \cos u \cos v \mp \sin u \sin v$$
$$\tan(u \pm v) = \frac{\tan u \pm \tan v}{1 \mp \tan u \tan v}$$

Double-Angle Formulas

$$\sin 2u = 2 \sin u \cos u$$
$$\cos 2u = \cos^2 u - \sin^2 u = 2\cos^2 u - 1 = 1 - 2\sin^2 u$$
$$\tan 2u = \frac{2\tan u}{1 - \tan^2 u}$$

Power-Reducing Formulas

$$\sin^2 u = \frac{1 - \cos 2u}{2}$$
$$\cos^2 u = \frac{1 + \cos 2u}{2}$$
$$\tan^2 u = \frac{1 - \cos 2u}{1 + \cos 2u}$$

Sum-to-Product Formulas

$$\sin u + \sin v = 2\sin\left(\frac{u+v}{2}\right)\cos\left(\frac{u-v}{2}\right)$$
$$\sin u - \sin v = 2\cos\left(\frac{u+v}{2}\right)\sin\left(\frac{u-v}{2}\right)$$
$$\cos u + \cos v = 2\cos\left(\frac{u+v}{2}\right)\cos\left(\frac{u-v}{2}\right)$$
$$\cos u - \cos v = -2\sin\left(\frac{u+v}{2}\right)\sin\left(\frac{u-v}{2}\right)$$

Product-to-Sum Formulas

$$\sin u \sin v = \frac{1}{2}[\cos(u - v) - \cos(u + v)]$$
$$\cos u \cos v = \frac{1}{2}[\cos(u - v) + \cos(u + v)]$$
$$\sin u \cos v = \frac{1}{2}[\sin(u + v) + \sin(u - v)]$$
$$\cos u \sin v = \frac{1}{2}[\sin(u + v) - \sin(u - v)]$$

Pre-Calc. Area of a triangle 1	Pre-Calc. Area of a triangle (SAS Formula) 2	Pre-Calc. Area of a trapezoid 3
Pre-Calc. Area of a circle 4	Pre-Calc. Circumference of a Circle 5	Pre-Calc. Lateral surface area of a cylinder 6
Pre-Calc. Total surface area of a cylinder 7	Pre-Calc. Surface area of a sphere 8	Pre-Calc. Volume of a prism 9
Pre-Calc. Volume of a pyramid 10	Pre-Calc. Volume of a cylinder 11	Pre-Calc. Volume of a cone 12
Pre-Calc. Volume of a sphere 13	Pre-Calc. Double angle identity for $\cos^2\theta$ 14	Pre-Calc. Double angle identity for $\sin^2\theta$ 15
Pre-Calc. $\sin\left(\frac{\pi}{2}-\theta\right)$ 16	Pre-Calc. $\tan\left(\frac{\pi}{2}-\theta\right)$ 17	Pre-Calc. $\sec\left(\frac{\pi}{2}-\theta\right)$ 18

$$A = \frac{h}{2}\left(b_1 + b_2\right)$$

$$A = \frac{1}{2}ab\sin C$$

$$A = \frac{1}{2}bh$$

$$S = 2\pi rh$$

$$C = 2\pi r$$
$$C = \pi d$$

$$A = \pi r^2$$

$$V = Bh$$
$B =$ Area of Base

$$S = 4\pi r^2$$

$$S = 2\pi rh + 2\pi r^2$$

$$V = \frac{1}{3}\pi r^2 h$$

$$V = \pi r^2 h$$

$$V = \frac{1}{3}Bh$$
$B =$ Area of Base

$$\frac{1}{2}\left(1 - \cos 2\theta\right)$$

$$\frac{1}{2}\left(1 + \cos 2\theta\right)$$

$$V = \frac{4}{3}\pi r^3$$

$$\csc\theta$$

$$\cot\theta$$

$$\cos\theta$$

Pre-Calc. $\cos^2\theta+\sin^2\theta$ 19	Pre-Calc. $1+\cot^2\theta$ 20	Pre-Calc. $1+\tan^2\theta$ 21
Pre-Calc. $\frac{1}{\sin\theta}$ 22	Pre-Calc. $\frac{1}{\cos\theta}$ 23	Pre-Calc. $\frac{1}{\tan\theta}$ 24
Pre-Calc. $\frac{\sin\theta}{\cos\theta}$ 25	Pre-Calc. $\frac{\cos\theta}{\sin\theta}$ 26	Pre-Calc. $\sin 2\theta$ 27
Pre-Calc. $\cos 2\theta$ (in terms of $\cos\theta$ and $\sin\theta$) 28	Pre-Calc. $\cos 2\theta$ (in terms of $\cos\theta$) 29	Pre-Calc. $\cos 2\theta$ (in terms of $\sin\theta$) 30
Pre-Calc. $\sin(-\theta)$ 31	Pre-Calc. $\cos(-\theta)$ 32	Pre-Calc. $\tan(-\theta)$ 33
Pre-Calc. Law of sines 34	Pre-Calc. Law of cosines 35	Pre-Calc. $\log_a b = c$ 36

$\sec^2\theta$

$\csc^2\theta$

1

$\cot\theta$

$\sec\theta$

$\csc\theta$

$2\sin\theta\cos\theta$

$\cot\theta$

$\tan\theta$

$1-2\sin^2\theta$

$2\cos^2\theta-1$

$\cos^2\theta-\sin^2\theta$

$-\tan\theta$

$\cos\theta$

$-\sin\theta$

$a^c=b$

$a^2=b^2+c^2-2bc\cos A$

$\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$

Pre-Calc. $\log(AB)$ 37	Pre-Calc. $\log\left(\frac{A}{B}\right)$ 38	Pre-Calc. $\log A^x$ 39
Pre-Calc. $\ln e$ 40	Pre-Calc. $\ln 1$ 41	Pre-Calc. $e^{\ln x}$ 42
Pre-Calc. Pythagorean Theorem 43	Pre-Calc. Distance between points (x_1, y_1) and (x_2, y_2) 44	Pre-Calc. Slope of the line between points (x_1, y_1) and (x_2, y_2) 45
Pre-Calc. Point-Slope equation of a line 46	Pre-Calc. Slope-Intercept equation of a line 47	Pre-Calc. Standard Form of the equation of a line 48
Pre-Calc. Circle with center at point (h, k) and radius *r* 49	Pre-Calc. Ellipse 50	Pre-Calc. Hyperbola 51
Pre-Calc. Hyperbola with axes as asymptotes 52	Pre-Calc. Parabola (vertical axis of symmetry) 53	Pre-Calc. Parabola (horizontal axis of symmetry) 54

$x \log A$

$\log A - \log B$

$\log A + \log B$

x

0

1

$m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$\sqrt{\left(x_2 - x_1\right)^2 - \left(y_2 - y_1\right)^2}$

$a^2 + b^2 = c^2$

$Ax + By = C$

$y = mx + b$

$y - y_1 = m\left(x - x_1\right)$

$Ax^2 - By^2 = C$

$Ax^2 + By^2 = C$

$\left(x - h\right)^2 + \left(y - k\right)^2 = r^2$

$x = ay^2 + by + c$

$y = ax^2 + bx + c$

$xy = k$

Pre-Calc. Domain of a function 55	Pre-Calc. Range of a function 56	Pre-Calc. Function symmetric across the *y*-axis 57
Pre-Calc. Even function 58	Pre-Calc. Function symmetric through the origin 59	Pre-Calc. Odd function 60
Pre-Calc. Quadratic formula (roots of $y = ax^2 + bx + c$) 61	Pre-Calc. Inverse of a function 62	Pre-Calc. To graph the inverse of a function… 63
Pre-Calc. To find the equation of the inverse of a function… 64	Pre-Calc. If point (a,b) lies on the inverse function f^{-1} then… 65	Pre-Calc. Inverse of $y = e^x$ 66
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$f(-x) = f(x)$

The set of all possible values of *y* for a function

The set of all possible values of *x* for a function

$f(-x) = -f(x)$

$f(-x) = -f(x)$

$f(-x) = f(x)$

reflect the graph of the function across the line $y = x$

$(f \circ f^{-1})(x) = x$

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$y = \ln x$

point (b, a) lies on function *f*

interchange x and y, then solve the equation for y

$y - y_1 = -\dfrac{1}{m}(x - x_1)$

or

$y = -\dfrac{1}{m}x + b_1$, where $b_1 = y_1 + \dfrac{x_1}{m}$

$y - y_1 = m(x - x_1)$

or

$y = mx + b_1$, where $b_1 = (y_1 - mx_1)$

$y = e^x$