

The exact instructions which will appear on the show-your-work portion of the exam are reproduced here.

**SHOW YOUR WORK**

For this portion of the exam you will be graded on the work that you show to solve the problem. If you do not show any work, you will not be given any credit. If you use your calculator for any part of a problem, you must write down your steps/graphs and how you arrived at your answer based on this information.

Here are several problems that may be similar to what will appear on the handwritten, show-your-work portion of the exam. You should attempt to write out complete solutions to these problems on separate paper.

Determine whether  $f(x)$  and  $g(x)$  are inverses.

1.  $f(x) = 5x - 9$  and  $g(x) = \frac{x+5}{9}$

2.  $f(x) = \frac{3}{x-4}$  and  $g(x) = \frac{3+4x}{x}$

3.  $f(x) = \sqrt[3]{x-4}$  and  $g(x) = x^3 + 4$

4.  $f(x) = \frac{7-2x}{x}$  and  $g(x) = \frac{7}{x+2}$

Find the inverse of each  $f(x)$  or state that it does not have an inverse. If the function has an inverse, state the domain and range of the original function and state the domain and range of the inverse.

5.  $f(x) = x^3 + 2$

6.  $f(x) = \frac{7}{x} - 3$

7.  $f(x) = \frac{2x-3}{x+1}$

Solve the following exponential equations.

8.  $10^{1-x} = 10^4$

9.  $4^{2x^2+2x} = 8$

10.  $4^{5-9x} = \frac{1}{8^{x-2}}$

11.  $5^{3x-2} = 125^{2x}$

Use the compound interest formula OR the continuously compounding interest formula to answer the following questions.

$$A = P \left( 1 + \frac{r}{n} \right)^{nt}$$

$$A = Pe^{rt}$$

12. Find the accumulated value of an investment of \$5000 for 10 years at an interest rate of 6.5% if the money is compounded:

a. Semiannually

b. Quarterly

c. Monthly

d. Continuously

13. Which investment option yields the greatest return on \$9000 after 5 years?

- a. 8.25% compounded quarterly
  - b. 8.3% compounded semiannually
  - c. 8% compounded continuously
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14. The 1986 explosion at the Chernobyl nuclear power plant in the former Soviet Union sent about 1000kg of radioactive cesium-137 into the atmosphere.

The function  $f(x) = 1000(0.5)^{\frac{x}{30}}$  describes the amount (in kg) of cesium-137 remaining in Chernobyl  $x$  years after 1986. If 100kg of cesium-137 remains in the atmosphere, the area is considered unsafe for human habitation. Determine if Chernobyl will be safe for human habitation in 2066.

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**Express the following logarithmic functions as exponential functions, then solve for the variable.**

15.  $\log_6(216) = y$

16.  $\log_b(27) = 3$

17.  $\log(100) = x$

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**Simplify the following logarithmic functions.**

18.  $\log_7(10)^7$

19.  $\ln(e)^7$

20.  $\ln\left(\frac{1}{e^6}\right)$

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**Use the properties of logarithms to expand the following expressions, simplifying completely.**

21.  $\log_7\left(\frac{7}{x}\right)$

22.  $\log_8\left(\frac{64}{\sqrt{x+1}}\right)$

23.  $\log_5\left(\frac{125}{y}\right)$

24.  $\ln(\sqrt{ex})$

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**Use the properties of logarithms to condense the following logarithmic expressions into a single logarithmic expression with coefficient of 1.**

25.  $5\log_b(x) + 6\log_b(y)$

26.  $2\ln(x) - \frac{1}{2}\ln(y)$

27.  $\frac{1}{2}(\log(7x) - \log(14y))$

28.  $\frac{1}{3}(5\ln(x+6) - \ln(x) - \ln(x^2 - 25))$

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Solve each logarithmic expression, exclude any values not in the domain of the original expression

29.  $\log_5(x) + \log_5(4x-1) = 1$

30.  $\log_2(x+2) - \log_2(x-5) = 3$

31.  $\log(5x+1) = \log(2x+3) + \log(2)$

32.  $\log_9(x) + \log_9(x-8) = 1$

33. The formula  $A = 37.3e^{0.00095t}$  models the population of California, in millions,  $t$  years after 2010.

- What was the population of California in 2010?
- What is the population of California predicted to be in 2030?
- When will the population of California reach 40 million?
- When will the population of California reach 60 million?

34. The function  $f(x) = 20(0.975)^x$  models the percentage of surface sunlight that reaches a depth of  $x$  feet beneath the surface of the ocean.

- At what depth (to the nearest foot) is there 1% of surface sunlight?
- At what depth (to the nearest foot) is there 4% of surface sunlight?
- What percentage of sunlight reaches a depth of 20 feet?

Complete the following tables using  $A = A_0e^{kt}$ .

35.

Country	Philippines	Pakistan	Colombia	Madagascar	Germany	Bulgaria
2010 Population (millions)	99.9	184.4	44.2	21.3	82.3	7.1
Projected 2050 Population (millions)			62.9	42.7	70.5	5.4
Projected Growth Rate, $k$	0.0095	0.0149				

36.

Radioactive Substance	Tritium	Krypton-85	Radium-226	Uranium-238	Arsenic-74	Calcium-47
Half-Life			1620 years	4560 years	17.5 days	113 hours
Decay Rate, $k$	5.5% per year	6.3% per year				

Use substitution, elimination or graphing to solve the following systems of equations.

37.  $2x - 3y = -13$   
 $y = 2x + 7$

38.  $2x + 5y = 1$   
 $-x + 6y = 8$

39.  $3x - 4y = x - y + 4$   
 $2x + 6y = 5y - 4$

40.  $y = -\frac{1}{2}x + 2$   
 $y = \frac{3}{4}x + 7$

41.  $2x - 7y = 2$   
 $3x + y = -20$

42.  $5x = 6y + 40$   
 $2y = 8 - 3x$

43.  $\frac{x}{6} - \frac{y}{2} = \frac{1}{3}$   
 $x + 2y = -3$

44.  $15x - 6y = 0$   
 $5x - 2y = 4$

45.  $6x - 3y = 12$   
 $y = 2x + 1$