

**No calculators**

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Excellence  
Bonus

1

Score

76

Put answers in the boxes provided. **Show high quality work for all answers.** Points may be awarded for this.

TA: ☐ Garo

☐ Sam

☐ Trevor

Section Time: ☐ 8am

☐ 6pm

☐ 5pm

☐ 7pm

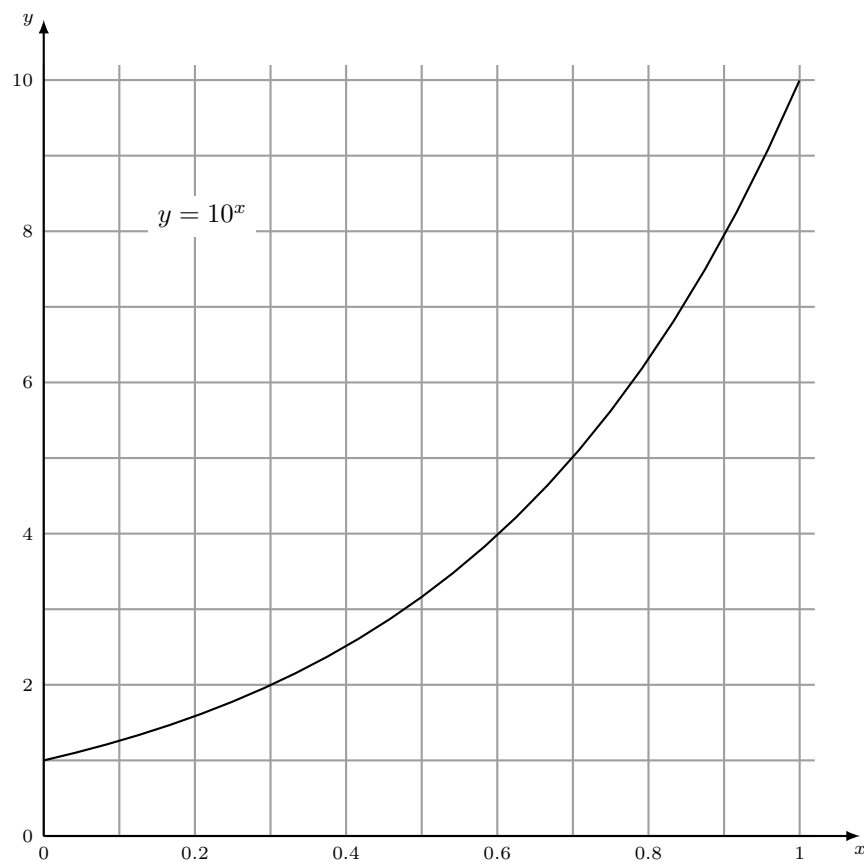
1. [     /6] Use the graph given to find the following as decimal numbers.

(a) If  $10^{2x} = 2900$ , then  $x =$

(b) Find  $2.8^{10} =$

(c) What is the slope of the graph at  $x = 0.3$ ?

slope =



**2.** [      /6] Let  $f(x) = 3x^5 - 7x^2$ . Find

(a)  $\frac{df}{dx} =$

(b)  $f''(x) =$

(c)  $f''(0) + f'(1) =$

**3.** [      /6] In this question  $k$  is a constant. Calculate

(a)  $\frac{d}{dx}(2e^{5x} + k^{-1}) =$

(b)  $\frac{d}{dx}((3x + k)^2) =$

(c)  $\frac{d}{dx}((3x + 5)/x^2) =$

4. [      /6] Let  $y = 2x^2 - 10x + 3$ .

(a) What is the value of  $x$  for which the slope of the graph is 2?

$x =$

(b) What value of  $x$  produces the minimum of this function?

$x =$

(c) Write the equation  $y = mx + b$  of the tangent line to the graph at  $x = 1$ .

$y =$

5. [      /8] Marie stands on top of a tower. She throws a ball into the air. After  $t$  seconds the height of ball above the tower in meters is  $20t - 5t^2$ .

The ball lands on the ground after 5 seconds.

- (a) How high is the tower?

meters

- (b) What was the speed of the ball after 3 seconds?

m/s

- (c) How high did the ball go **above the tower**?

meters

- (d) When was the ball going down at a speed of 3 m/s?

At  $t =$

seconds

6. [      /6] A tank initially contains 15 liters of blue paint. Then red paint enters the tank at a rate of 4 liters/hour.

(a) How many liters of paint are in the tank after  $t$  hours?

liters

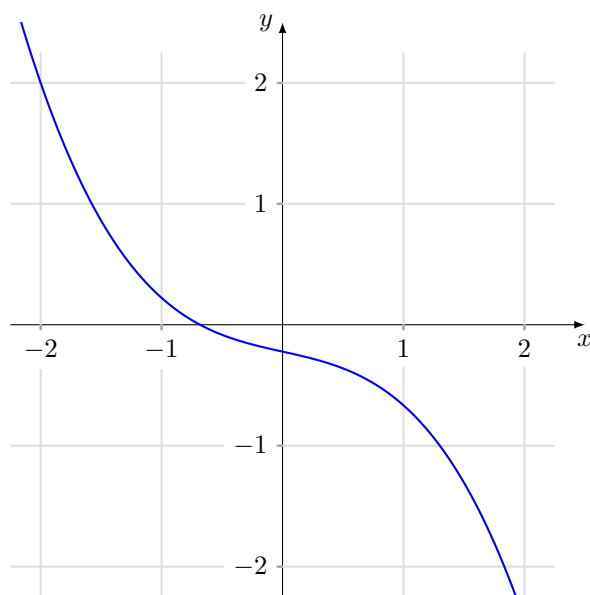
(b) What is the percentage of red paint in the tank after  $t$  hours?

%

(c) How many hours until 25% of the paint in the tank is red?

hours

7. [      /6] Here is the graph of  $y = f(x)$ :



(a) For which value of  $x$  is  $f'(x) = -1$ ?

$x =$

(b) For which values of  $x$  is  $f''(x) > 0$ ?

(c) What is the slope of the graph at  $x = 0$ ?

slope =

8. [ 1/6] A rectangular water tank has a base which is 5 meters by 2 meters. The table shows the depth of water in the tank at various numbers of hours over a period of time.

hours	0	2	7	10	15	18	20
meters	20	18	15	12	8	5	4

- (a) On average, how many cubic meters per hour were used during the period?

$\text{m}^3/\text{hr}$

- (b) When did the tank drain slowest?

From  $t =$ to  $t =$

- (c) How many  $\text{m}^3/\text{hr}$  were used during the period the tank drained slowest?

$\text{m}^3/\text{hr}$

9. [      /6] Let  $f(x) = 5e^x - 3x$ .

(a) Find  $f'(0)$ .

$f'(0) =$

(b) Find the tangent line approximation to  $y = f(x)$  at  $x = 0$ .

$f(x) \approx$

(c) Use this to find an approximate value of  $f(0.1)$ .

$f(0.1) \approx$

10. [      /6] Initially Jason is in Paris and Marie is in Rome. The road from Rome to Paris is 1100 km long. They both start driving at the same time. Jason drives at speed  $J$  for the first hour, then speeds up to speed  $2J$ . Marie drives at constant speed  $M$ . They meet after 3 hours. After 1 hour of driving, they are 820 km apart.

(a) Write two equations that express these facts.

Equation #1:

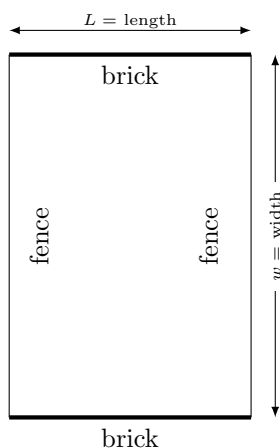
Equation #2:

(b) What was *Marie's* speed?

km/hr



11. [ /8] A rectangular field has a fence along two opposite sides and a brick wall along the other two sides. Fence costs \$5 per meter and brick costs \$40 per meter



- (a) Express the total cost of the fence and brick in terms of the length and width of the field.

cost =

- (b) The area of the field will be  $230 \text{ m}^2$ . Express the **total number of meters of fence needed** in terms of the width  $w$  of the field.

amount of fence =

meters

- (c) Use this to express the total cost of brick and fence in terms of the width  $w$ .

cost =

- (d) What should the width of the field be so the cost is smallest? (You can leave a square root in your answer.)

width =

meters

12. [      /6] Freds Friendly Flying Fortress airline will sell all their tickets at the same price. If the ticket price is \$200, they sell 2400 tickets. For each dollar Fred increases the price, the number of tickets sold is reduced by 4.

(a) If tickets are sold for  $\$(200 + x)$  each, how many are sold?

 tickets

(b) Express the total amount of money Fred gets by selling tickets for  $\$(200 + x)$  each. ***Simplify your answer.***

amount =

(c) What ***price should the ticket*** be for Fred to get the most money?

price =