

Do your work and circle final answers on separate paper, provided. Remember, to write big and bold, but mostly bold, or your teacher can't read it and give you any points for it. Leave a margin for the staple!

1. 5 people are going to be chosen out of 20 people to sit on stage at an awards ceremony.
 - a. (10pts) How many ways can the 5 people be chosen?
 - b. (10 pts) How many ways could you choose the 5 people and arrange their seating on stage?
2. (10 pts) Write the equation of the ellipse $9x^2 + 16y^2 - 90x + 96y = -225$ in the standard form $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$. This requires completing the square *twice*.
3. (10 pts) Sketch the graph of the ellipse $\frac{(x+4)^2}{9} + \frac{(y-5)^2}{4} = 1$, showing its center, vertices and foci.
4. The half-life of a weird radioactive isotope of molybdenum is 3300 years.
 - a. (10 pts) Model this situation with an exponential decay function $A(t) = A_0 e^{kt}$.
 - b. (5 pts) How old is a sample of molybdenum, if it has 27% of the radioactive alloy normally found in nature remaining?
5. A club is selling cookies at an event to raise money. They start with some money in the cash box for making change. After selling 10 cookies, there is \$ 67.50 in the cashbox. After selling 30 cookies, there is \$ 92.50 in the cashbox.
 - a. (5 pts) What's the price of a cookie?
 - b. (5 pts) How much was in the cash box to start with?
6. (10 pts) Use the Binomial Theorem (or Pascal's Triangle) to expand $(x-3y)^5$. No points awarded for doing this by brute force.
7. (10 pts) John can finish a job in 5 hours that it takes Bill 8 hours to finish. Suppose Bill shows up and starts working 2 hours before John shows up, and then they work together until the job is done. How many hours do each of the two end up working?

$$x + 2y - 4z = -23$$

8. (10 pts) Solve the system of linear equations: $-2x - 3y + 5z = 26$.

$$3x + 4y - 5z = -22$$

Answer any four (4) of the following Bonus Questions for up to 20 bonus points.

B 1 (5 pts) Let $f(x) = 14 \log_4(-4x - 8) + 7$. Find $f^{-1}(x)$.

B 2 (5 pts) Solve $|-3x - 5| - 4 < 8$

B 3 Consider the finite geometric sum $3 + \frac{3}{4} + \frac{3}{16} + \dots + \frac{3}{16384}$.

a) (5 pts) Determine a , r and n for the sum.

b) (5 pts) Use a , r , and n to determine the *exact* value of the sum $\sum_{k=1}^n a \cdot r^{k-1} = a \left(\frac{1-r^n}{1-r} \right)$. For full credit, submit your answer as a (possibly improper) fraction, in lowest terms. Decimal answers are worth at most 9 points.

c) (5 pts) Derive the formula used in part b).

B 4 (5 pts) Find the sum of the infinite geometric series $\sum_{k=1}^{\infty} 5 \cdot \left(\frac{2}{3} \right)^{k-1}$.

$$\text{Future Value of Annuity: } FV = R \left(\frac{\left(1 + \frac{r}{m}\right)^{mt} - 1}{\left(\frac{r}{m}\right)} \right) = R \left(\frac{(1+i)^n - 1}{i} \right) \quad \text{Future Value of Savings: } A = P \left(1 + \frac{r}{m}\right)^{mt} = P(1+i)^n$$

B 5 (5 pts) (**Present Value of Annuity**) If your monthly house payments are \$700, and the loan is for 30 years, at 4.25% annual percentage rate, compounded monthly, how much did you borrow in the first place?

B 6 (5 pts) Re-write $f(x) = 4x^2 - 3x + 1$ in the form $a(x-h)^2 + k$.