You begin your first job, and taking the advice of your math instructor, you start saving for retirement immediately. **SCORE: _____ / 4 PTS**
Your first month, you deposit $97 into your account. Each month after that, you deposit $8 more than you deposited the previous month.
You leave the job the day before your $3^{rd}$ anniversary. How much money did you deposit into the retirement account altogether ?

$97 + 105 + 113 + \cdots$ (+8, +8)

ARITHMETIC SERIES $d = 8$

3 YEARS = 36 MONTHS

$$S_{36} = \frac{1}{2}(36)(2(97) + (35)(8)) \quad (1)\ (1\tfrac{1}{2})$$

$$= 18(194 + 280)$$

$$= 18(474) = \$8{,}532 \quad (1)\ (\tfrac{1}{2})$$

Find the $6^{th}$ term of the sequence defined recursively by $a_1 = 1, \quad a_2 = -1, \quad a_{n+2} = na_{n+1} - 2a_n$ for $n \geq 1$. **SCORE: _____ / 4 PTS**

$n=1$: $a_3 = 1a_2 - 2a_1 = 1(-1) - 2(1) = -3$ (1)

$n=2$: $a_4 = 2a_3 - 2a_2 = 2(-3) - 2(-1) = -4$ (1)

$n=3$: $a_5 = 3a_4 - 2a_3 = 3(-4) - 2(-3) = -6$ (1)

$n=4$: $a_6 = 4a_5 - 2a_4 = 4(-6) - 2(-4) = -16$ (1)

Find the value of $\sum_{k=6}^{9}(-1)^{k-1}(k^2-(k-5)!)$.

**SCORE: ____ / 5 PTS**

$= (-1)^5(6^2-1!) + (-1)^6(7^2-2!) + (-1)^7(8^2-3!) + (-1)^8(9^2-4!)$

$= -(36-1) + (49-2) - (64-6) + (81-24)$

$= \underset{(1)}{-35} \underset{(1)}{+47} \underset{(1)}{-58} \underset{(1)}{+57}$

$= 11$ (1)

Find the sum of the first $20$ terms of the series $\frac{9}{4}+\frac{11}{6}+\frac{17}{12}+1+\cdots$.

**SCORE: _____ / 4 PTS**

$\frac{11}{6}-\frac{9}{4}=\frac{22-27}{12}=-\frac{5}{12}$

$\frac{17}{12}-\frac{11}{6}=\frac{17-22}{12}=-\frac{5}{12}$

$1-\frac{17}{12}=\frac{12-17}{12}=-\frac{5}{12}$

ARITHMETIC SERIES

$d=-\frac{5}{12}$ (1)

$S_{20}=\frac{1}{2}(20)(2(\frac{9}{4})+19(\frac{-5}{12}))$ (1) (1½)

$=10(\frac{9}{2}-\frac{95}{12})$

$=10(\frac{54-95}{12})$

$=10^{5}(\frac{-41}{12_{6}})=-\frac{205}{6}$ (½)

Consider the geometric sequence with $a_1 = -32$ and $a_4 = 108$.

**SCORE: _____ / 6 PTS**

[a] Find the formula for $a_n$.

$a_n = a_1 r^{n-1}$

$a_4 = a_1 r^3$

(1) $108 = -32r^3$

$r^3 = -\frac{108}{32} = -\frac{27}{8} \longrightarrow r = -\frac{3}{2}$ (1)

$a_n = -32\left(-\frac{3}{2}\right)^{n-1}$ (1)

[b] Find the sum of the first 9 terms of the sequence above.

$S_9 = \boxed{\frac{-32\left(1-\left(-\frac{3}{2}\right)^9\right)}{1-\left(-\frac{3}{2}\right)}} = \frac{-32\left(1-\left(-\frac{3}{2}\right)^9\right)}{\frac{5}{2}} \cdot \frac{2}{2} = \frac{-64}{5}\left(1-\left(-\frac{3}{2}\right)^9\right)$

(2) (1)

Simplify $\frac{(n-3)!}{(n-6)!}$. **NOTE: Your final answer can be in factored form.**

**SCORE: _____ / 3 PTS**

$$\frac{(n-3)(n-4)(n-5)(n-6)!}{(n-6)!} = (n-3)(n-4)(n-5)$$

$1\frac{1}{2}$ $1\frac{1}{2}$

Write $\frac{25}{192}-\frac{36}{96}+\frac{49}{48}-\frac{64}{24}+\frac{81}{12}-\frac{100}{6}$ using sigma notation.

**SCORE:** _____ / 4 PTS

$5^2$ $6^2$ $7^2$ $8^2$ $9^2$ $10^2$

$*\frac{1}{2}$ $*\frac{1}{2}$ $*\frac{1}{2}$ $*\frac{1}{2}$ $*\frac{1}{2}$

$\frac{96}{192}=\frac{1}{2}$

GEOMETRIC SEQUENCE

$r=\frac{1}{2}$

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$$\sum_{i=1}^{6}(-1)^{i+1}\frac{(i+4)^2}{192\left(\frac{1}{2}\right)^{i-1}} \quad \text{OR} \quad \sum_{i=1}^{6}\frac{(i+4)^2}{192\left(-\frac{1}{2}\right)^{i-1}} \quad \text{OR} \quad \sum_{i=1}^{6}\frac{(-2)^{i-1}(i+4)^2}{192}$$