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DEPARTMENT: COMPUTER SCIENCE (200 Level)

COURSE; FOUNDATIONS OF COMPUTER SCIENCE (CSC 242)

Assignment.

1. $\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{(3n-2)(3n+1)} = \frac{n}{(3n+1)}$

for $n = 1$

$\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{(3(1)-2)(3(1)+1)} = \frac{1}{(3(1)+1)}$

$\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{3(5)} = \frac{1}{3(5)}$

$\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{15} = \frac{1}{15}$; True for $n = 1$

for $n = k$

$\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{(3k-2)(3k+1)} = \frac{k}{3k+1}$ ---- eqn 1

for $n = k+1$

$\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{(3(k+1)-2)(3(k+1)+1)} = \frac{k+1}{(3(k+1)+1)}$

$\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{(3k+1)(3k+2)} = \frac{k+1}{3k+2}$

add $\frac{1}{(3k+1)(3k+2)}$ to both side of eqn 1

$\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{(3k-2)(3k+1)} + \frac{1}{(3k+1)(3k+2)} = \frac{k}{3k+1} + \frac{1}{(3k+1)(3k+2)}$

$= \frac{(3k+2)k+1}{(3k+1)(3k+2)}$

$= \frac{3k^2+2k+1}{(3k+1)(3k+2)}$

Since it is not factorizable, therefore

$\frac{1}{1\cdot4} + \frac{1}{4\cdot7} + \frac{1}{7\cdot10} + \cdots + \frac{1}{(3k+1)(3k+2)} \neq \frac{k+1}{3k+2}$

2.

Question 2

$$\frac{1}{3\cdot 5}+\frac{1}{5\cdot 7}+\frac{1}{7\cdot 9}+\cdots+\frac{1}{(2n+1)(2n+3)}=\frac{n}{3(2n+3)}$$

for $n=1$

$$\frac{1}{3\cdot 5}+\frac{1}{5\cdot 7}+\frac{1}{7\cdot 9}+\cdots+\frac{1}{(2(1)+1)(2(1)+3)}=\frac{1}{3(2(1)+3)}$$

$$\frac{1}{3\cdot 5}+\frac{1}{5\cdot 7}+\frac{1}{7\cdot 9}+\cdots+\frac{1}{15}=\frac{1}{15}$$; True for $n=1$

for $n=k$

$$\frac{1}{3\cdot 5}+\frac{1}{5\cdot 7}+\frac{1}{7\cdot 9}+\cdots+\frac{1}{(2k+1)(2k+3)}=\frac{k}{3(2k+3)} \quad \text{--- eqn 1}$$

for $n=k+1$

$$\frac{1}{3\cdot 5}+\frac{1}{5\cdot 7}+\frac{1}{7\cdot 9}+\cdots+\frac{1}{(2(k+1)+1)(2(2k+1)+3)}=\frac{k+1}{3(2(k+1)+3)}$$

$$\frac{1}{3\cdot 5}+\frac{1}{5\cdot 7}+\frac{1}{7\cdot 9}+\cdots+\frac{1}{(2k+3)(2k+5)}=\frac{k+1}{3(2k+5)}$$

add $\frac{1}{(2k+3)(2k+5)}$ to both sides of eqn 1.

$$\frac{1}{3\cdot 5}+\frac{1}{5\cdot 7}+\frac{1}{7\cdot 9}+\cdots+\frac{1}{(2k+1)(2k+3)}+\frac{1}{(2k+3)(2k+5)}=\frac{k}{3(2k+3)}+\frac{1}{(2k+3)(2k+5)}$$

$$=\frac{(2k+5)k+3}{3(2k+3)(2k+5)}$$

$$=\frac{2k^2+5k+3}{3(2k+3)(2k+5}=\frac{(k+1)\cancel{(2k+3)}}{3\cancel{(2k+3)}(2k+5)}$$

$$=\frac{(k+1)}{3(2k+5)}$$

Hence,

$$\frac{1}{3\cdot 5}+\frac{1}{5\cdot 7}+\frac{1}{7\cdot 9}+\cdots+\frac{1}{(2k+3)(2k+5)}=\frac{k+1}{3(2k+5)}$$

Question 3

$n(n+1)(n+5)$ is a multiple of 3; Prove by mathematical Induction

When $n=1$

$1(1+1)(1+5) = 2(6) = 12$; 12 is a multiple of 3.

$n=k$

$k(k+1)(k+5) = (k^2+k)(k+5)$

$= k^3+5k^2+k^2+5k$

$= k^3+6k^2+5k$

for $n = k+1$

$(k+1)(k+2)(k+6) = (k^2+2k+k+2)(k+6)$

$= (k^2+3k+2)(k+6)$

$= k^3+3k^2+2k+6k^2+18k+12$

$= k^3+9k^2+20k+12$

$= (k^3+6k^2+5k) + 3k^2+15k+12$

$= (k^2+k)(k+5) + (3k+3)(k+4)$

$= (k^2+k)(k+5) + 3(k+1)(k+4)$

Since $(k^2+k)(k+5)$ is ~~divisible by~~ a multiple of 3 and $3(k+1)(k+4)$ is also a multiple of 3, therefore $(k^2+k)(k+5)+3(k+1)(k+4)$ is ~~divisible~~ a multiple of 3.