

```

p = 3.141592

approx = (p - float('%0f'%p)) / p
approx = abs(approx)
perc = approx * 100
print(f"i = 1: relative error = {'%8.6f'%approx}, {'%4.2f'%perc}%")

approx = (p - float('%1f'%p)) / p
approx = abs(approx)
perc = approx * 100
print(f"i = 2: relative error = {'%8.6f'%approx}, {'%4.2f'%perc}%")

approx = (p - float('%2f'%p)) / p
approx = abs(approx)
perc = approx * 100
print(f"i = 3: relative error = {'%8.6f'%approx}, {'%4.2f'%perc}%")

approx = (p - float('%3f'%p)) / p
approx = abs(approx)
perc = approx * 100
print(f"i = 4: relative error = {'%8.6f'%approx}, {'%4.2f'%perc}%")

approx = (p - float('%4f'%p)) / p
approx = abs(approx)
perc = approx * 100
print(f"i = 5: relative error = {'%8.6f'%approx}, {'%4.2f'%perc}%")

approx = (p - float('%5f'%p)) / p
approx = abs(approx)
perc = approx * 100
print(f"i = 6: relative error = {'%8.6f'%approx}, {'%4.2f'%perc}%")

approx = (p - float('%6f'%p)) / p
approx = abs(approx)
perc = approx * 100
print(f"i = 7: relative error = {'%8.6f'%approx}, {'%4.2f'%perc}%")

i = 1: relative error = 0.045070, 4.51%
i = 2: relative error = 0.013239, 1.32%
i = 3: relative error = 0.000507, 0.05%
i = 4: relative error = 0.000130, 0.01%
i = 5: relative error = 0.000003, 0.00%
i = 6: relative error = 0.000001, 0.00%
i = 7: relative error = 0.000000, 0.00%

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```

def sigfigs(err):
    n = 0
    threshold = 5 * 10 ** (-n)
    while err < threshold:
        n += 1
        threshold = 5 * 10 ** (-n)

    return n-1

def F(n):
    print(n)
    t2 = t3 = 0
    for j in range(n):
        t = 2 * j + 1
        num = 4 * (-1) ** j
        den2 = t * (2 ** t)
        den3 = t * (3 ** t)
        t2 += num / den2
        t3 += num / den3

    pi = (t2 + t3)
    err = abs(1 - (pi/p))
    sig = sigfigs(err)

    print(f"j = {n}: q_j = {'%5.3f'%pi}")
    print(f"relative error : {'%5.3f'%err}")
    print(f"sigfigs = {sig}")
    print()

    if sig < 4:
        n += 1
        n = F(n)

    return n

n = F(1)
j = 1: q_j = 3.333
relative error : 0.061
sigfigs = 1

j = 2: q_j = 3.117
relative error : 0.008
sigfigs = 2

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j = 3: q_j = 3.146
relative error : 0.001
sigfigs = 3
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```
j = 4: q_j = 3.141
relative error : 0.000
sigfigs = 4
```

3c)

```
def pi(n):
    pin = 0
    for j in range(n):
        num = (-1) ** j
        den = 2 * j + 1
        pin += num / den

    return 4*pin

pinum = pi(n)
print(f"pi = {pinum}")
print(f"rel_err = {abs(1 - (pinum / p))}")

pi = 2.8952380952380956
rel_err = 0.07841689969986698
```