PES UNIVERSITY

EC -Campus

MAXIMA LAB

Subject: Engineering Mathematics-II

Subject Code: UE19MA151

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SRN : PES2UG19CS315

Section: E

Marks awarded: **Name of the faculty:**

PROBLEM STATEMENT:

The population of a city grows at a rate proportional to the number of people presently living in the city. If after two years the population has doubed and after three years the population is 20000, estimate the number of people currently living in the city.

SYNOPSIS AND FORMULATION:

The above mentioned problem will be solved using wxMaxima.

As the population of a city grows at a rate proportional to the number of people presently living in the city, it is an exponential function.

dp/dt=kp

=.>dp/p=kdt

Upon integration,

ln(p)=kt+c

taking exponential on b.s,

$\mathbf{p = e^{kt} .e^{c}}$

therefore $\mathbf{p=c.e^{kt}}$

C->initial value of population

P->Population at time t

Given that **p at t=2 is 2c**

=.> $2c = c.\, e^{2k}$

=.> $2k = \ln(2)$

=.> $k = \ln(2)/2 = 0.3466$

Also given that $p = 20000$ at $t = 3$

=.> $20000 = c\, .\, e^{0.3466}$

=.> $c = 7070$

Therefore initial population is 7070.

CONCLUSION:

Value of k = 0.3466

Initial population is obtained by substituting values of k, t, and p in the equation

$p = c.e^{kt}$

for the condition ,p=20000 at t=3.

Therefore initial population turns out to be 7070.

CODE:

```
→       kill(all);
(%o0)   done

(%i2)   f:exp(integrate(1/p,p));
(f)     p

(%i3)   r:exp(integrate(k,t));
(r)     %e^(k t)

(%i4)   F: f=c·r;
(F)     p=c %e^(k t)

(%i5)   A:F;
(A)     p=c %e^(k t)

(%i6)   F:subst(t=2,F);
(F)     p=c %e^(2 k)

(%i7)   F:subst(p=2·c,F);
(F)     2 c=c %e^(2 k)

(%i8)   solve(F,k);
```

(%o8) $[k=\log(-\sqrt{2}), k=\frac{\log(2)}{2}]$

```
(%i9)   A:subst(k=ln(2)/2,A);
```

(A) $p=c\ \%e^{\frac{\ln(2)\,t}{2}}$

```
(%i10)  A:subst(p=20000,A);
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(A) $20000=c\ \%e^{\frac{\ln(2)\,t}{2}}$

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(%i11)  A:subst(t=3,A);
```

(A) $20000=\%e^{\frac{3\ln(2)}{2}}\,c$

```
(%i12)  solve(A,c);
```

(%o12) $[c=20000\ \%e^{-\frac{3\ln(2)}{2}}]$

Which is approximately 7070.