Today

- Brief midterm “discussion”
- Euler’s method

I thought the midterm was...

(A) ...easier than I expected.

(B) ...pretty much what I expected.

(C) ...harder than I expected.

Midterm 2...

- On the graphing question, did you
- calculate the zeros, crit pts, potential IPS? (A) T, (B) F
- figure out which crit pts were min/max? (A) T, (B) F
- check that the sign of f" changed sign at each pIP? (A) T, (B) F
- That was all worth 11 pts. 3 pts for the actual graph.

The most useful thing I did to study was...

(A) ...doing/reviewing WeBWorK assignments.

(B) ...doing/reviewing OSH.

(C) ...doing practice problems from the course notes.

(D) ...reading/annotating/taking notes on the course notes.

(E) ...reviewing the lecture slides.

The second most useful thing I did to study was...

(A) ...doing/reviewing WeBWorK assignments.

(B) ...doing/reviewing OSH.

(C) ...doing practice problems from the course notes.

(D) ...reading/annotating/taking notes on the course notes.

(E) ...reviewing the lecture slides.

Other things?

Third-party prep session

(A) I attended a third-party prep session.

(B) I did not attend a third-party prep session.

Third-party prep session

(A) I would recommend it to other students for the time spent attending it and the practice problems distributed.

(B) I would recommend it to other students only for the time spent attending it.

(C) I would recommend it to other students only for the practice problems distributed.

(D) I would not recommend it.

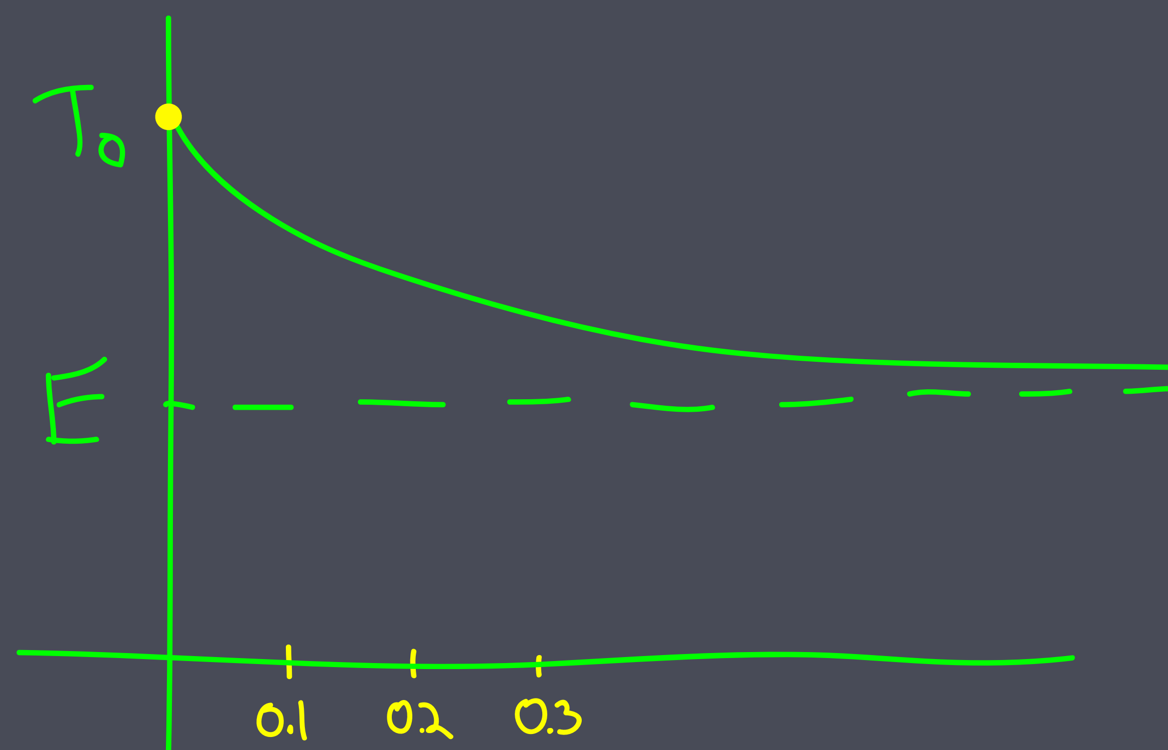
Euler's method

- A "numerical" method for IVPs.
- "Numerical" means finding a sequence of numbers that approximate y(t) at specific t values.
- e.g. Instead of the actual solution to NLC

$$T(t) = E + (T_0-E)e^{-kt},$$

we find T_1, T_2, T_3,... which approximate T(0.1), T(0.2), T(0.3) ...

Euler's method for $T'(t)=0.02(14-T(t))$ with $T(0)=37$.



What is the slope of the solution at $t=0$?

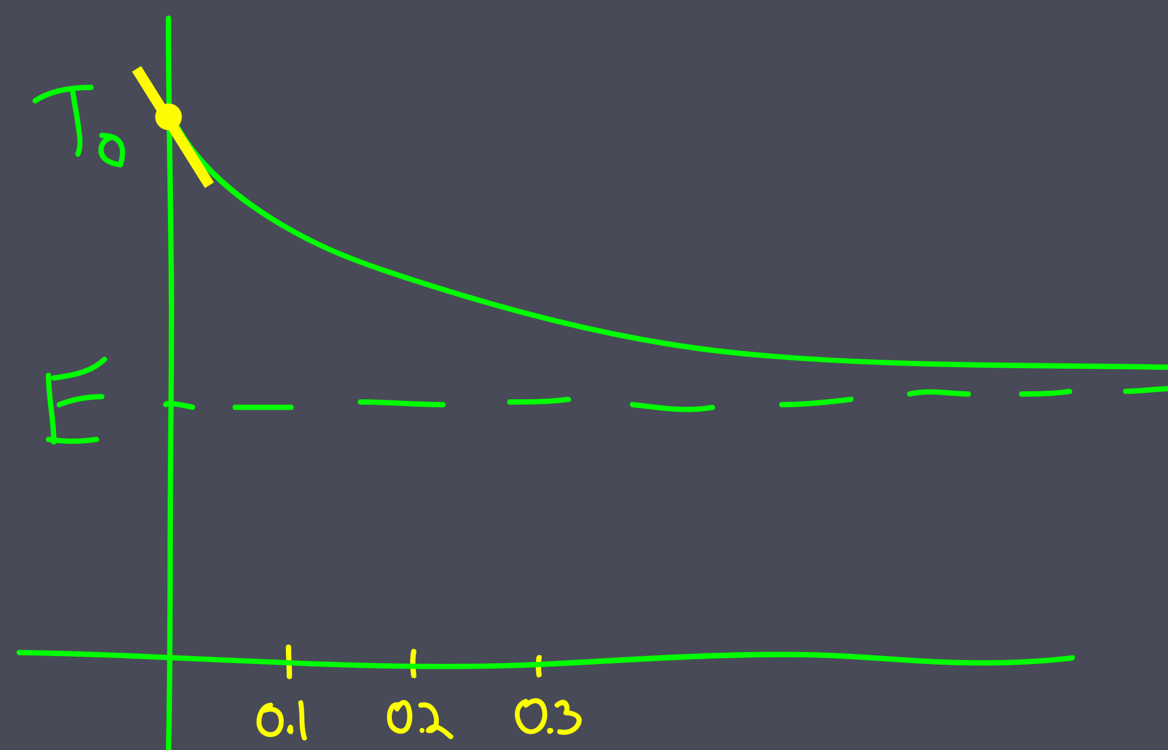
(A) -0.02

(B) -0.46

(C) 0.02

(D) -0.28

Euler's method for $T'(t)=0.02(14-T(t))$ with $T(0)=37$.



What is the slope of the solution at t=0?

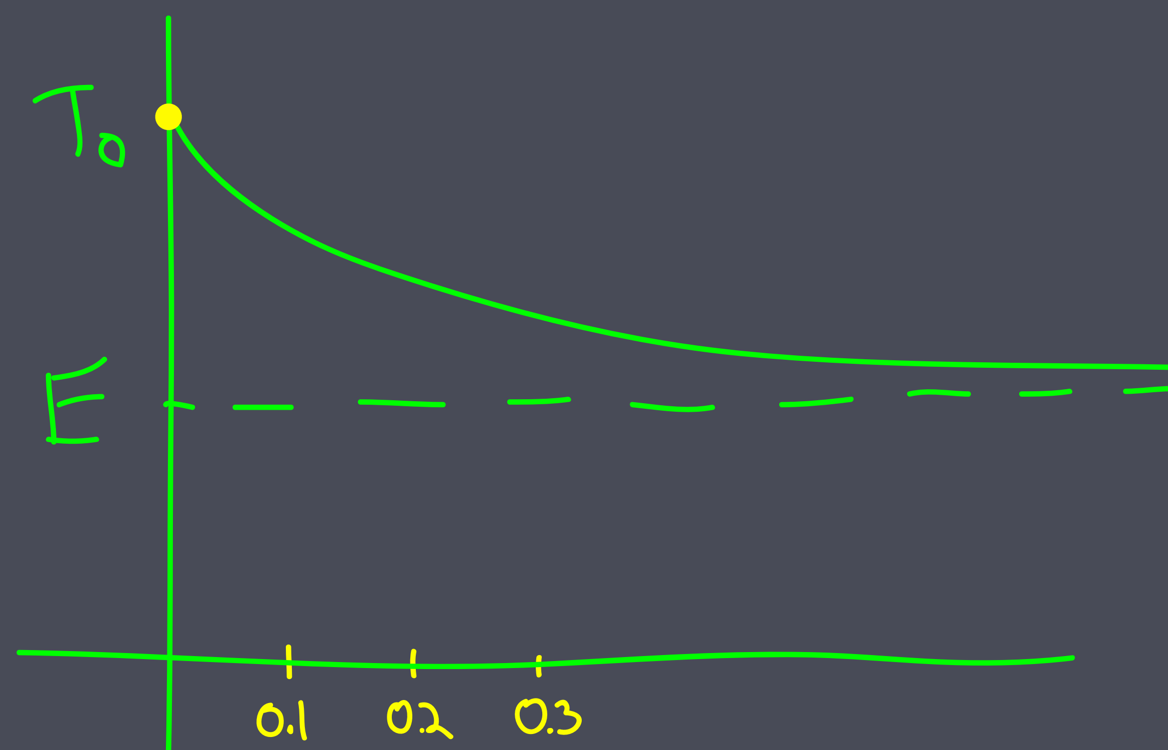
(A) -0.02

(B) -0.46

(C) 0.02

(D) -0.28

Euler's method for $T'(t)=k(E-T(t))$ with $T(0)=T_0$.



What is the slope of the solution at $t=0$?

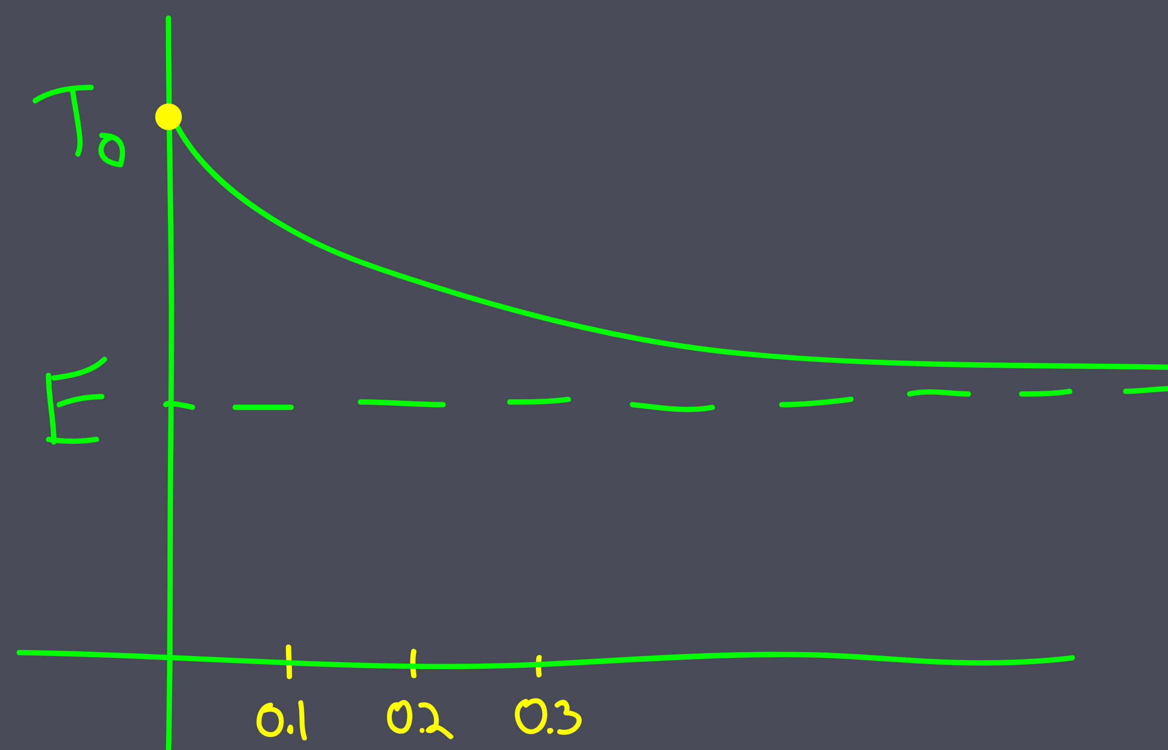
(A) $k(E-T)$

(B) $k(E-T_0)$

(C) $T'(0)$

(D) kE

Euler's method for $T'(t)=k(E-T(t))$ with $T(0)=T_0$.



What is the slope of the solution at $t=0$?

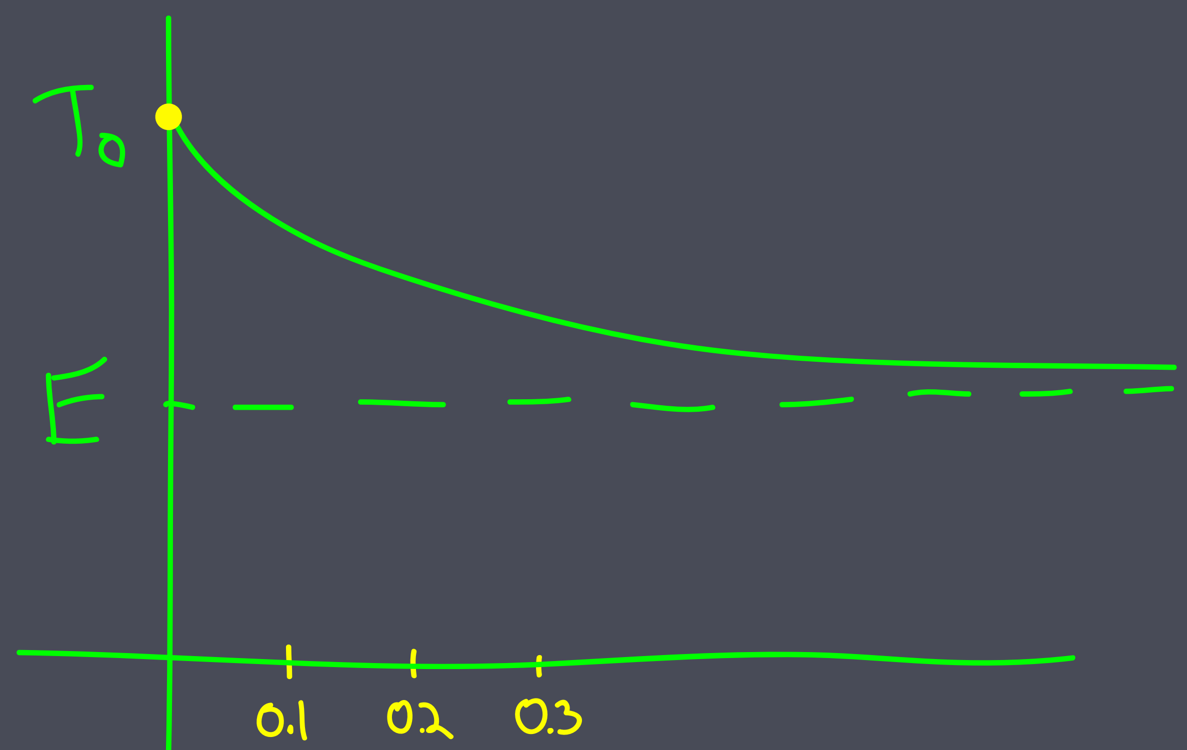
(A) $k(E-T)$

(B) $k(E-T_0)$

(C) $T'(0)$ <-- yes, but can do better

(D) kE

Euler's method for $T'(t)=0.02(14-T(t))$ with $T(0)=37$.



What is the equation of the tangent line to $T(t)$ at $t=0$?

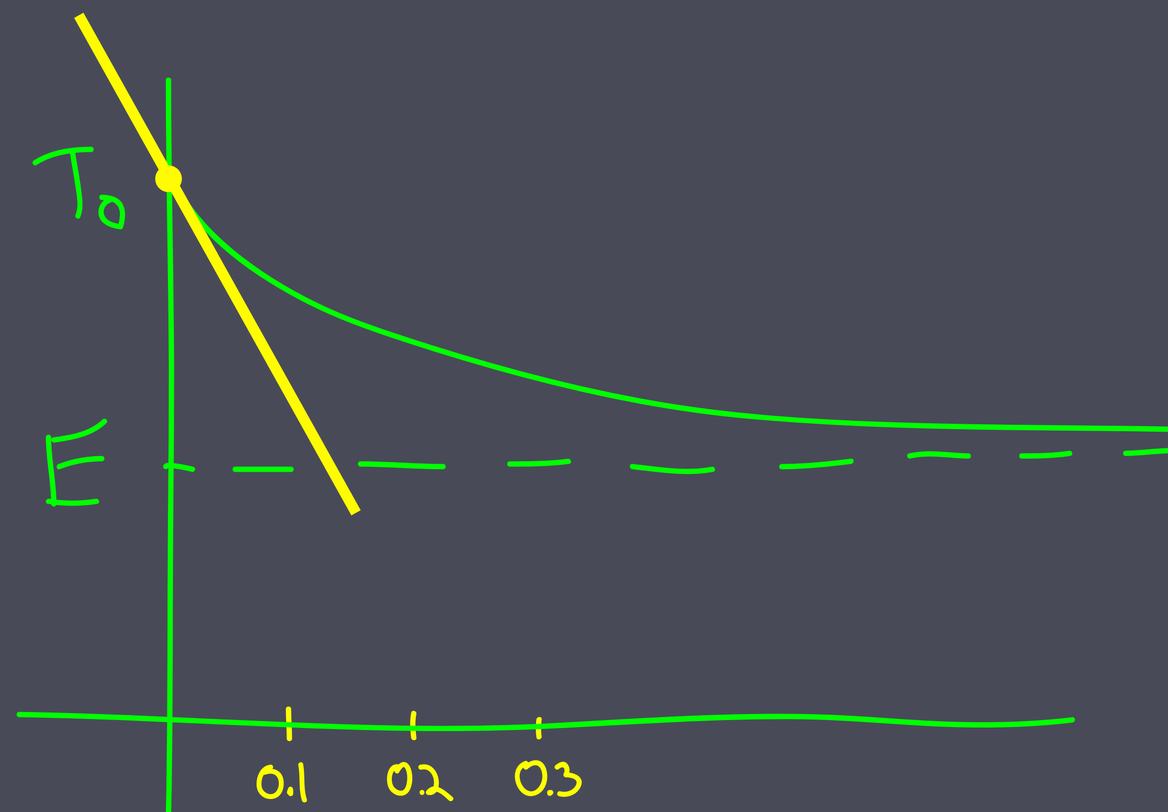
(A) $y = 37 - 0.46t$

(B) $y = 14 + 23e^{-0.02t}$

(C) $y = 37 - 0.28\ t$

(D) $y = 37 + 0.46t$

Euler's method for $T'(t)=0.02(14-T(t))$ with $T(0)=37$.



What is the equation of the tangent line to $T(t)$ at $t=0$?

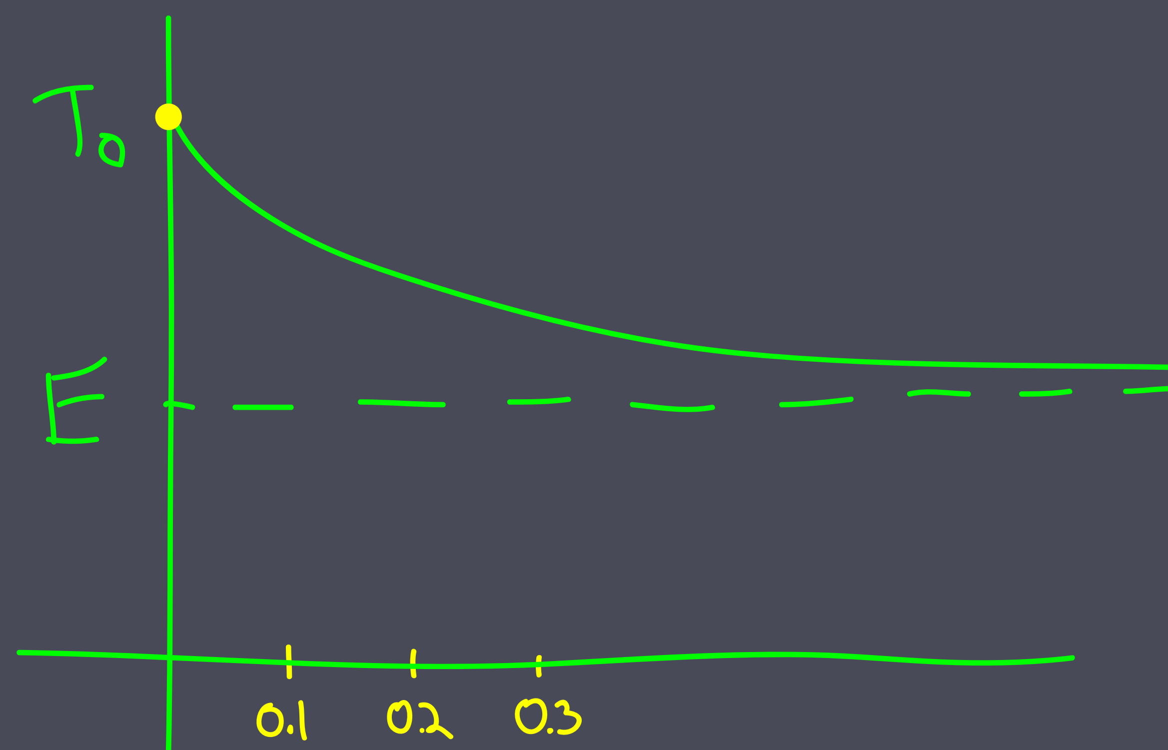
(A) $y = 37 - 0.46t$

(B) $y = 14 + 23e^{-0.02t}$

(C) $y = 37 - 0.28\,t$

(D) $y = 37 + 0.46t$

Euler's method for $T'(t)=k(E-T(t))$ with $T(0)=T_0$.



What is the equation of the tangent line to $T(t)$ at $t=0$?

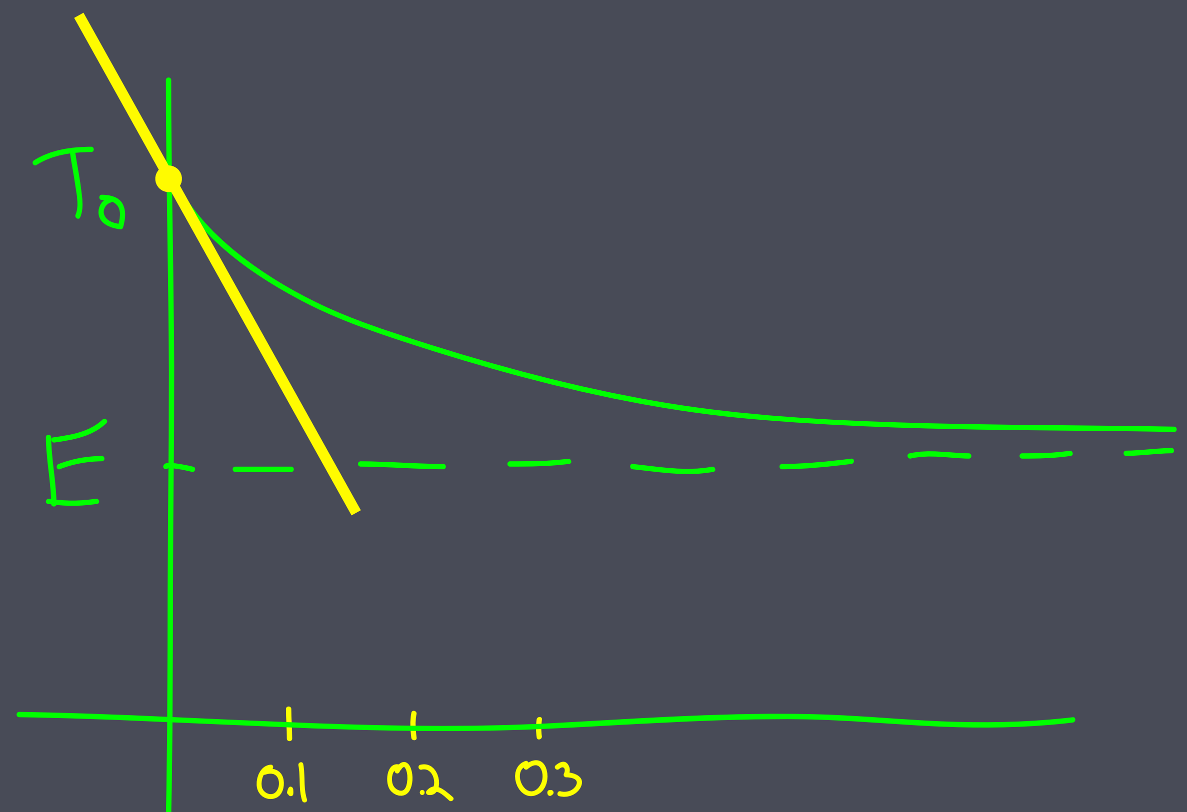
(A) $y = T(0) + T'(0)(t-0)$

(B) $y = E + (T_0-E)e^{-kt}$

(C) $y = T_0 + T_0'\, t$

(D) $y = T_0 + k(E-T_0)t$

Euler's method for $T'(t)=k(E-T(t))$ with $T(0)=T_0$.



What is the equation of the tangent line to $T(t)$ at $t=0$?

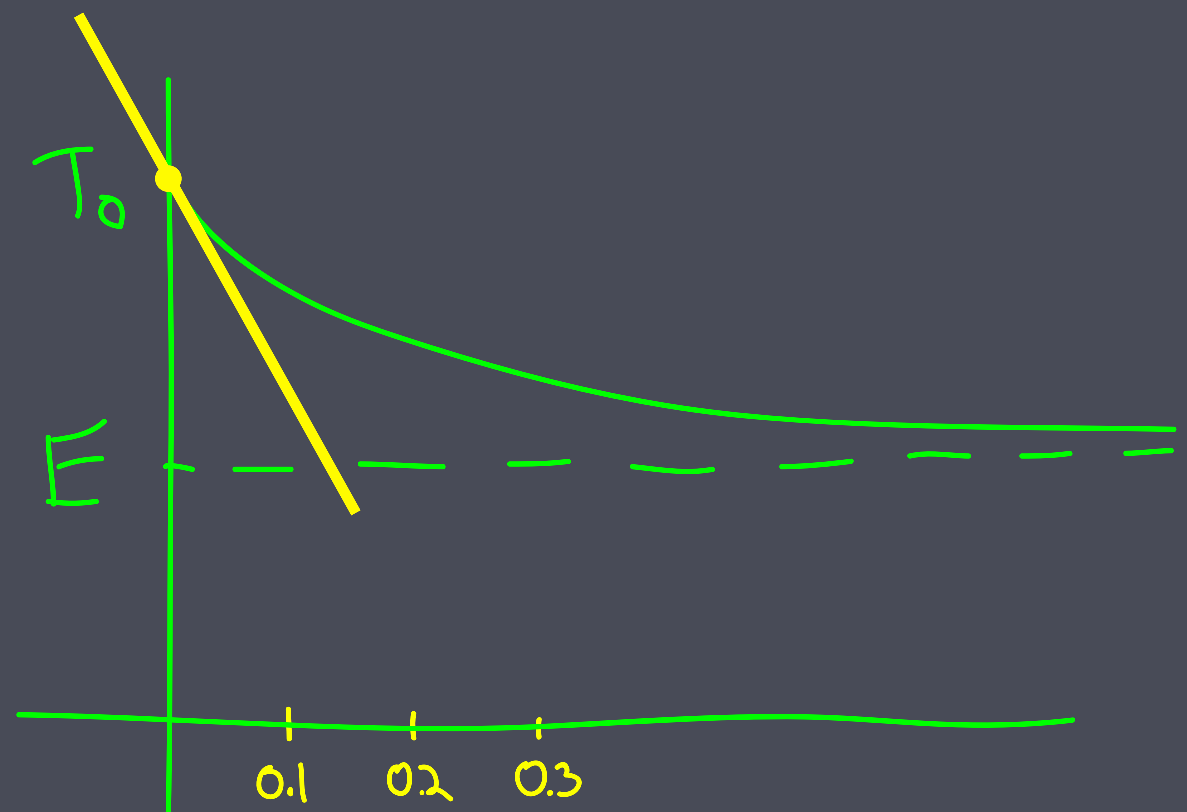
(A) $y = T(0) + T'(0)(t-0)$

(C) $y = T_0 + T_0'\, t$

(B) $y = E + (T_0-E)e^{-kt}$

(D) $y = T_0 + k(E-T_0)t$

Euler's method for $T'(t)=k(E-T(t))$ with $T(0)=T_0$.



Use the tangent line at t=0 to estimate T(0.1):

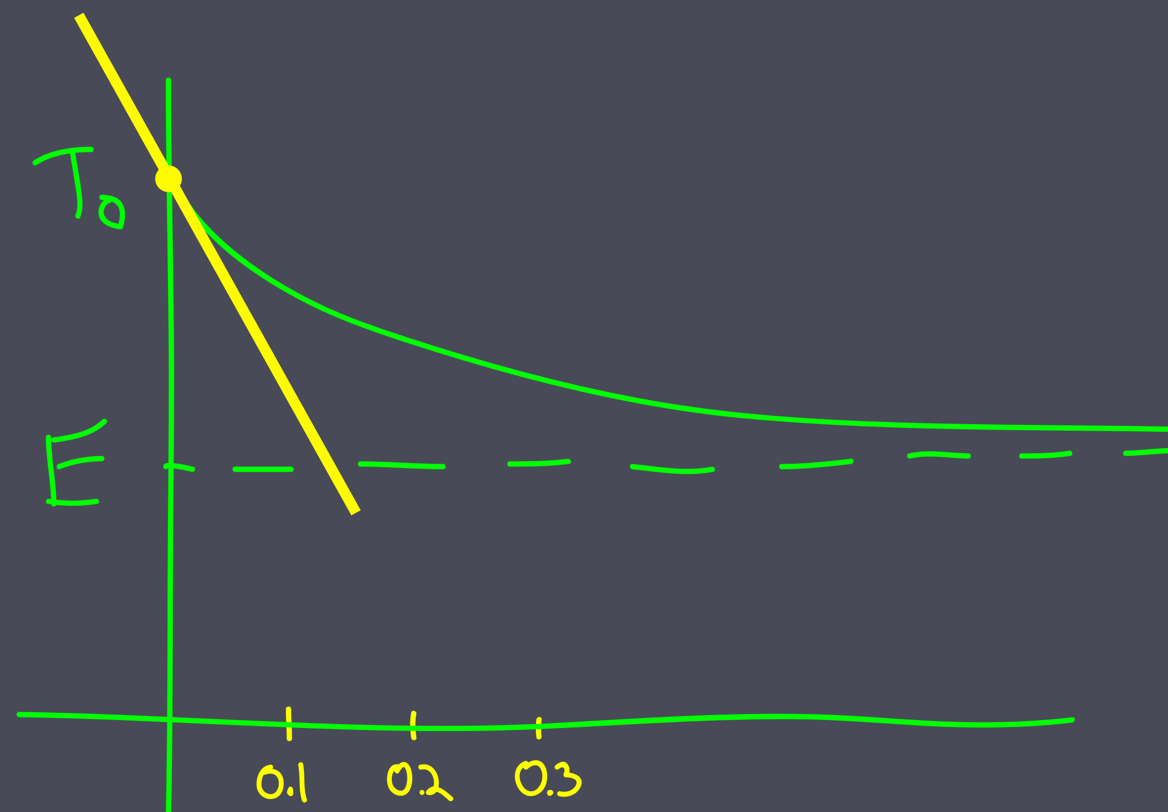
(A) $T_1 = T(0) + 0.1\, T'(0)$

(B) $T_1 = T_0 + 0.1\, k(E-T_0)$

(C) $T_1 = E + (T_0-E)e^{-0.1k}$

(D) $T_1 = T_0 + 0.1\, k$

Euler's method for $T'(t)=k(E-T(t))$ with $T(0)=T_0$.



Use the tangent line at t=0 to estimate T(0.1):

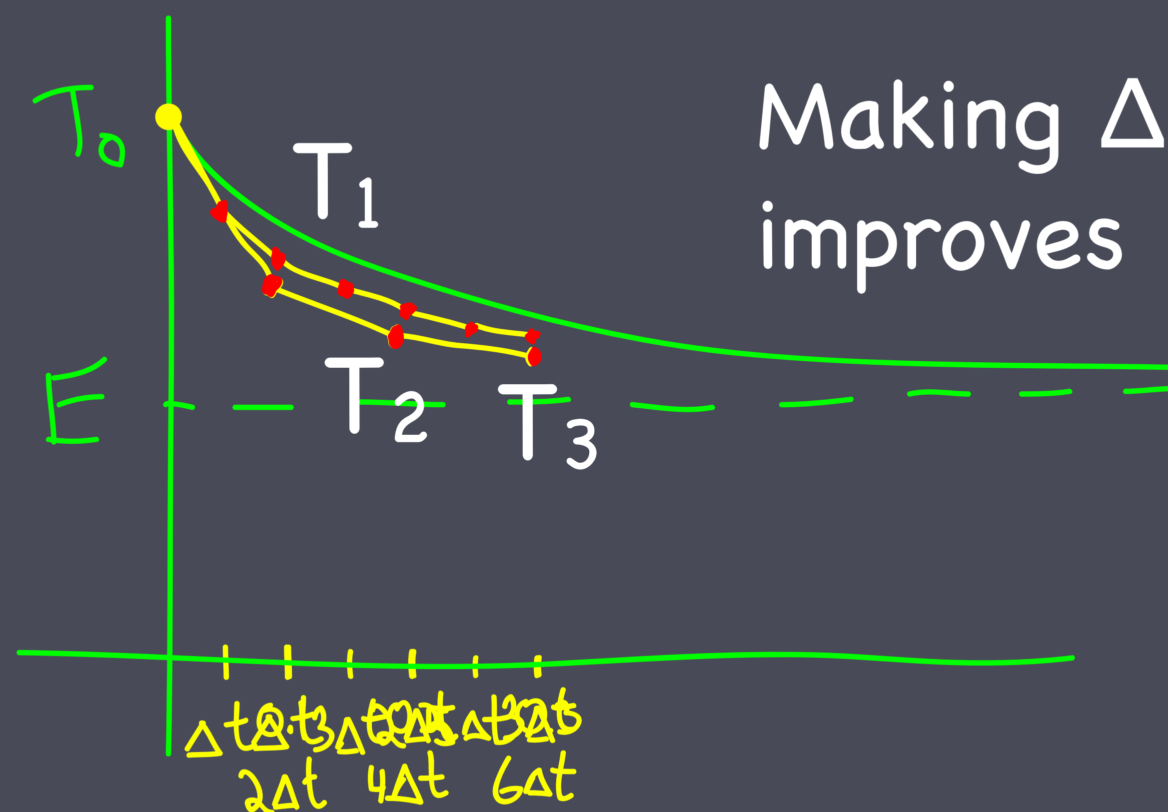
(A) $T_1 = T(0) + 0.1\, T'(0)$

(B) $T_1 = T_0 + 0.1\, k(E-T_0)$

(C) $T_1 = E + (T_0-E)e^{-0.1k}$

(D) $T_1 = T_0 + 0.1\, k$

Euler's method for $T'(t)=k(E-T(t))$ with $T(0)=T_0$.



Making Δt smaller improves the estimate.

$$T(0.1) \approx T_0 + \Delta t\ k\ (E-T_0) \quad = T_1$$

$$T_2 = T_1 + \Delta t\ k\ (E-T_1)$$

$$T_3 = T_2 + \Delta t\ k\ (E-T_2)$$

When will Euler's method underestimate the true solution?

(A) When the derivative of the true solution is positive.

(B) When the derivative of the true solution is negative.

(C) When the second derivative of the true solution is positive.

(D) When the second derivative of the true solution is negative.