Today

- Foraging - a complicated example that I'll use to emphasize the value of thinking about the problem in biological, graphical and formulaic terms.
- Reminders:
  - Assignment 5 due Thursday
  - No class on Monday (Thanksgiving)
  - OSH 4 due Wednesday
  - Regular PLQs.

Foraging

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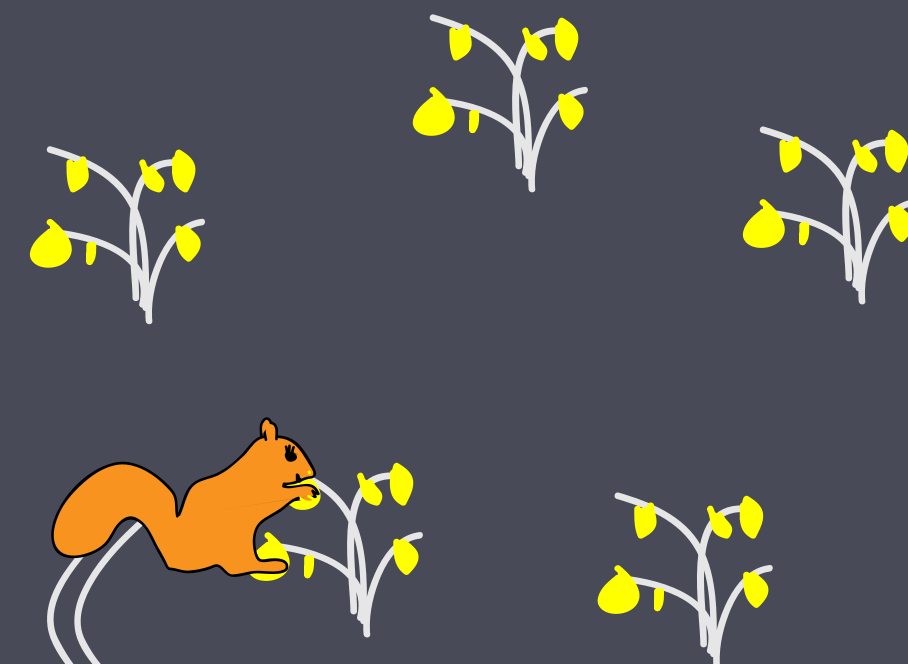
Foraging time includes

Foraging



Foraging time includes

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Foraging

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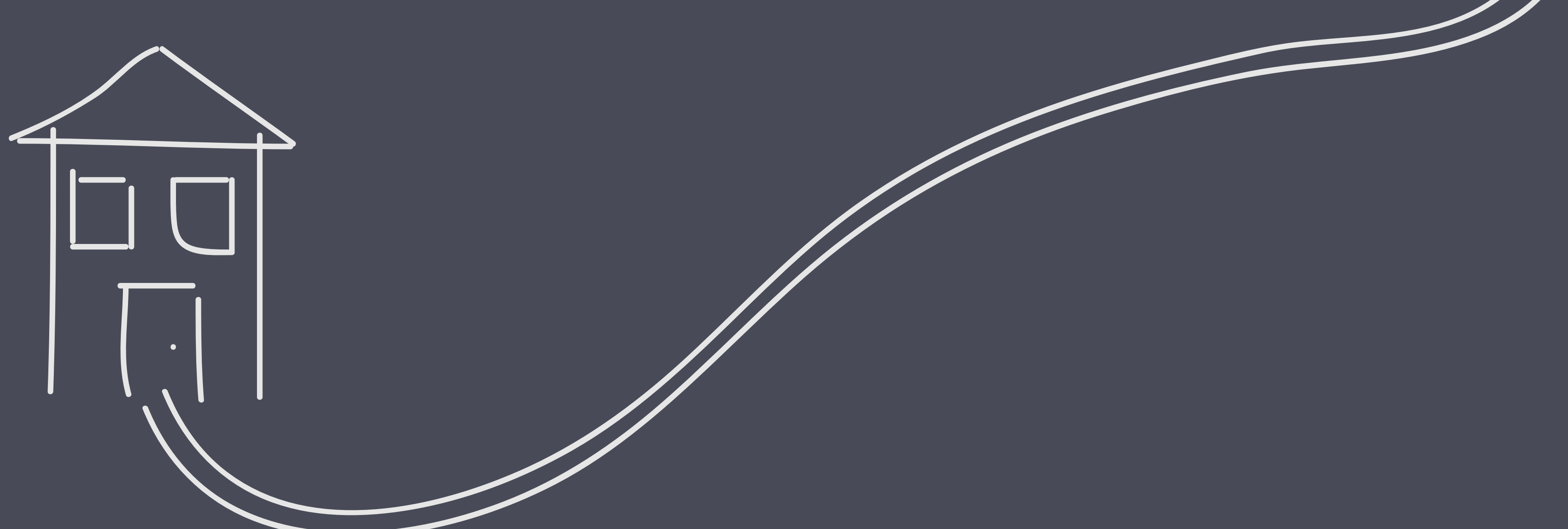
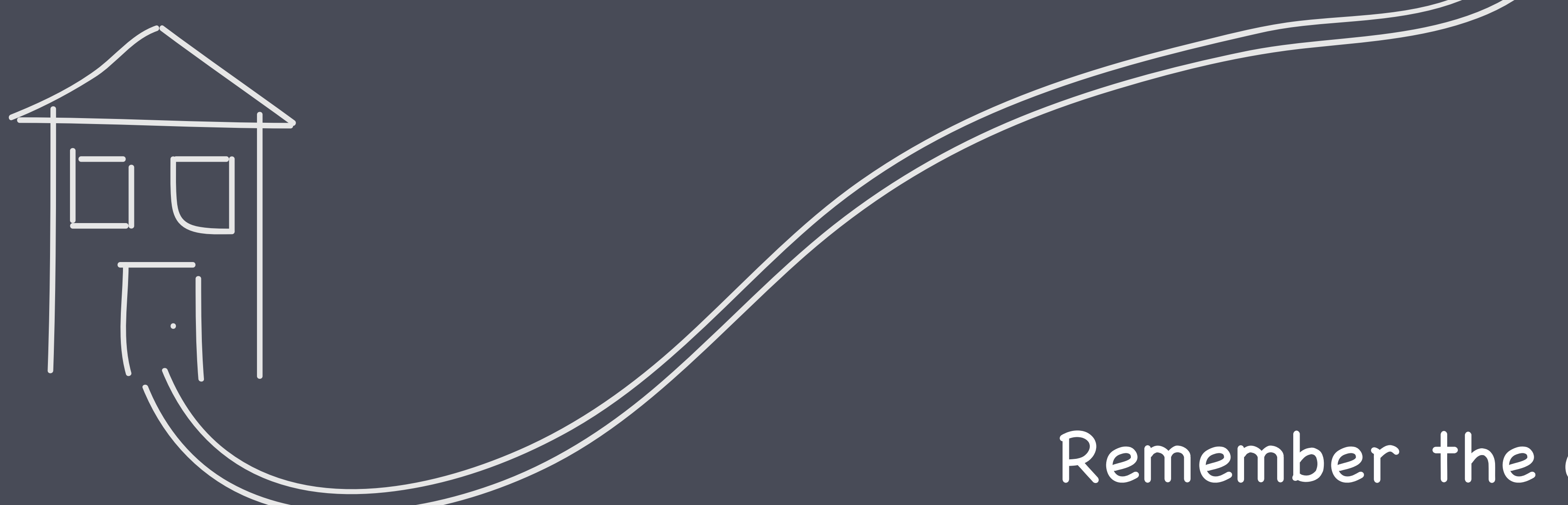
- a commute (t_0 --> constant),
- a visit to each patch (nt_p)



Foraging

Foraging success is characterized by $f(t_p)$ = resource extracted from a single patch after a time t_p spent in the patch.



Remember the definition of $f(t_p)$ for an upcoming clicker Q.

Foraging

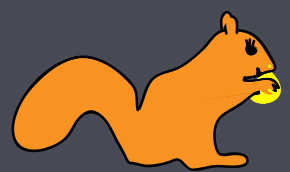
(A) When food is scarce, it is best to maximize R(t).

(B) When food is scarce, it is best to maximize E(t).

(C) When food is abundant, with many competing priorities to deal with, it is best to maximize E(t).

(D) Maximizing E(t) and maximizing R(t) are the same.

(E) When food is abundant, it is best to maximize E(t).



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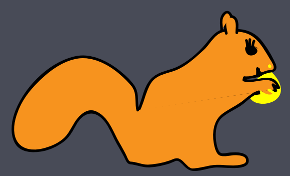
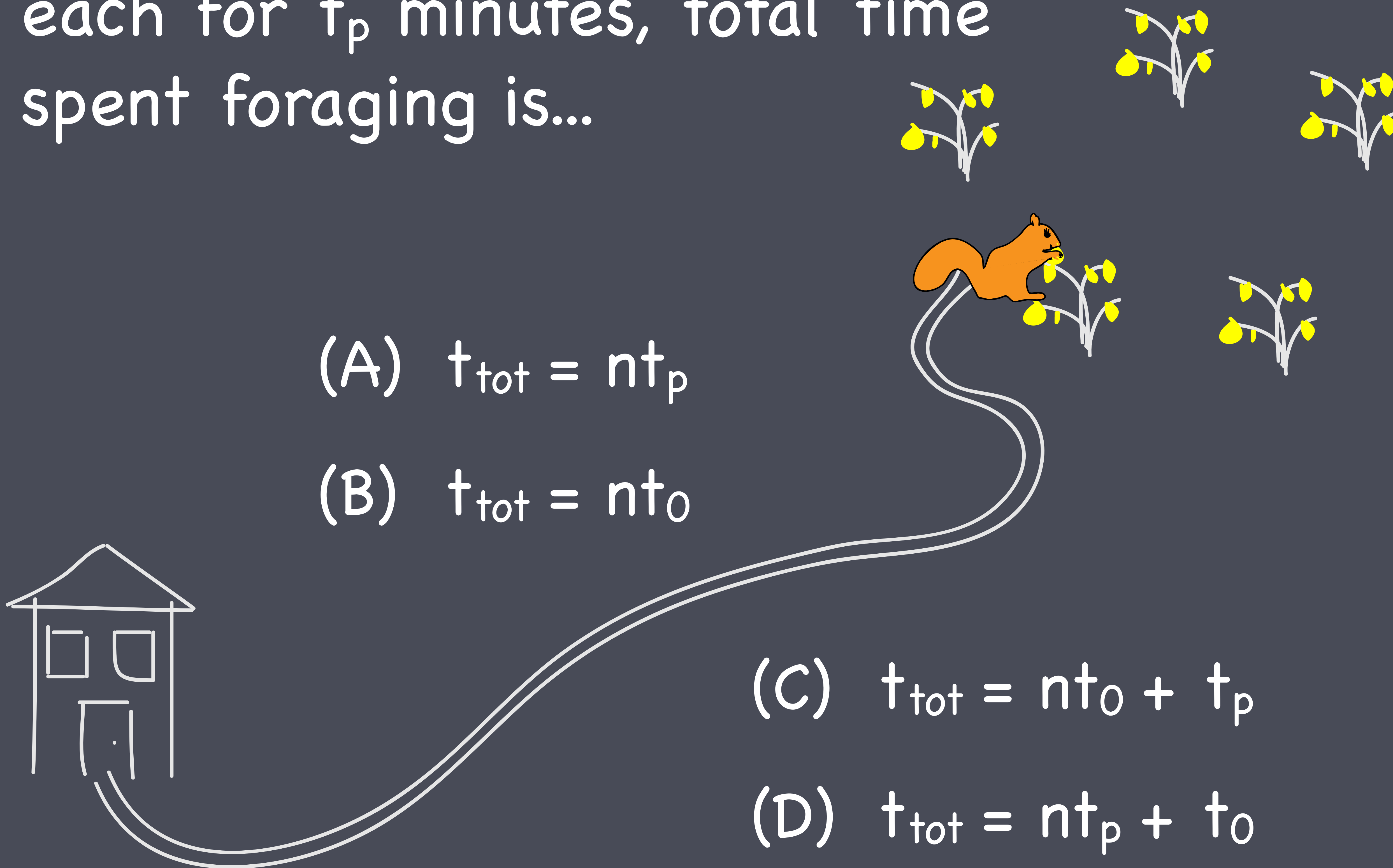


Foraging

Maximize average rate of resource extraction, that is, how fast the squirrel gathers food.

If the squirrel visits n patches, each for t_p minutes, total time spent foraging is...



(A) $t_{tot} = nt_p$

(B) $t_{tot} = nt_0$

(C) $t_{tot} = nt_0 + t_p$

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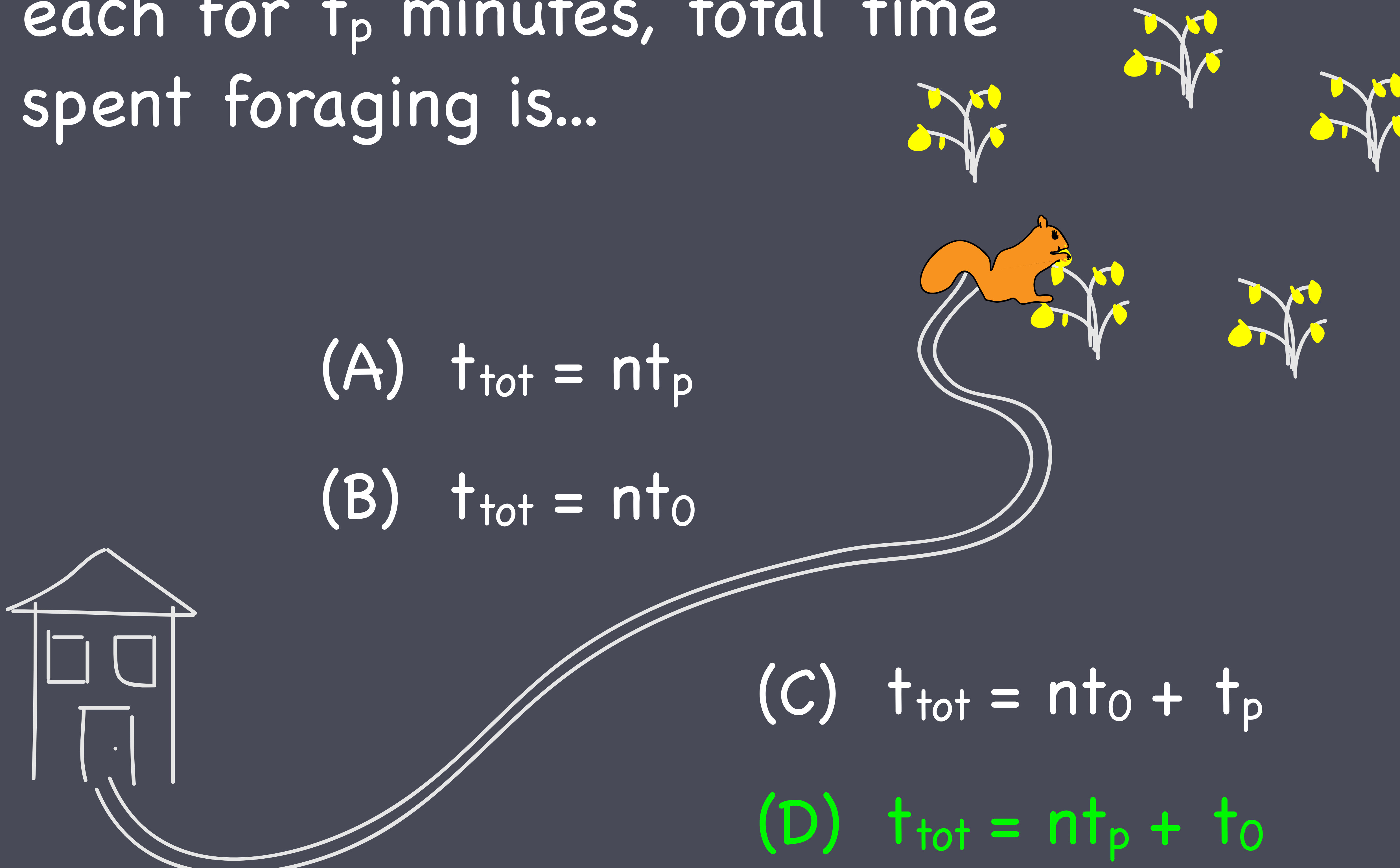

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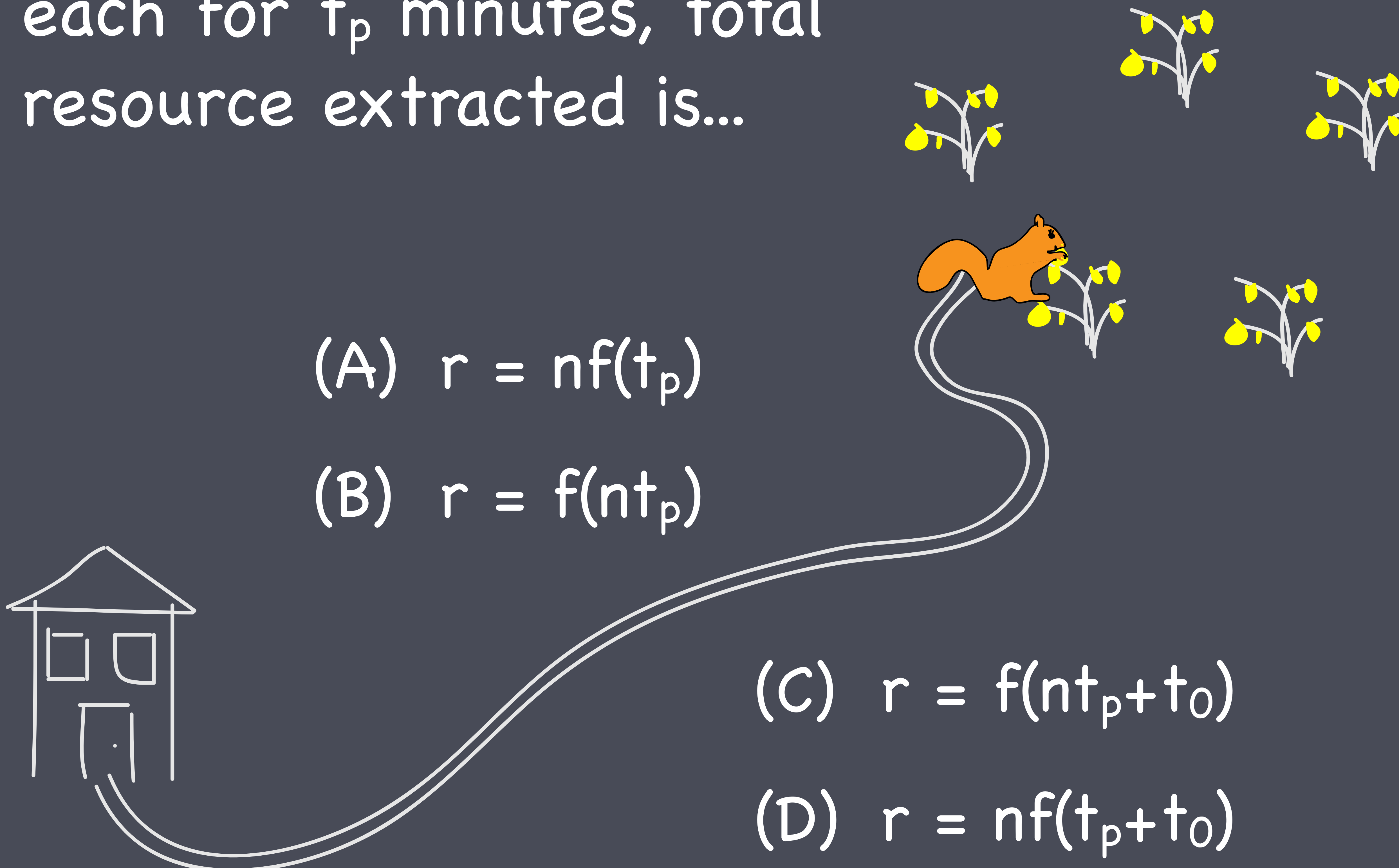
If the squirrel visits n patches, each for t_p minutes, total resource extracted is...

(A) $r = nf(t_p)$

(B) $r = f(nt_p)$



(C) $r = f(nt_p+t_0)$

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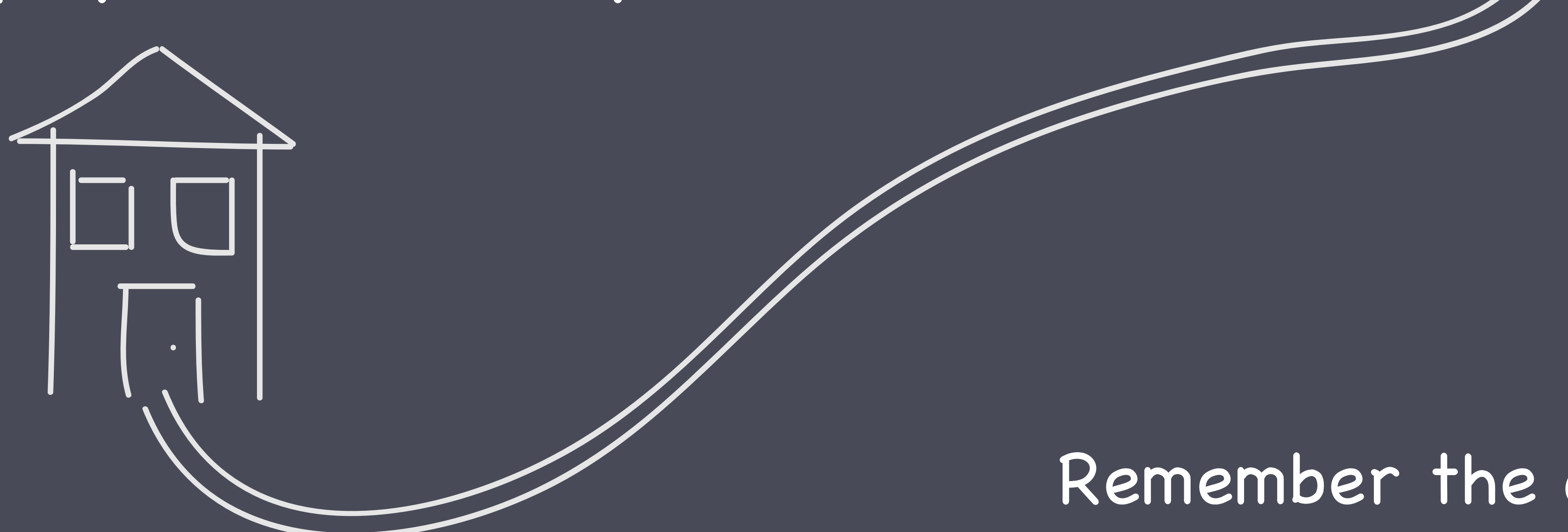

Remember the definition of $f(t_p)$ for an upcoming clicker Q.

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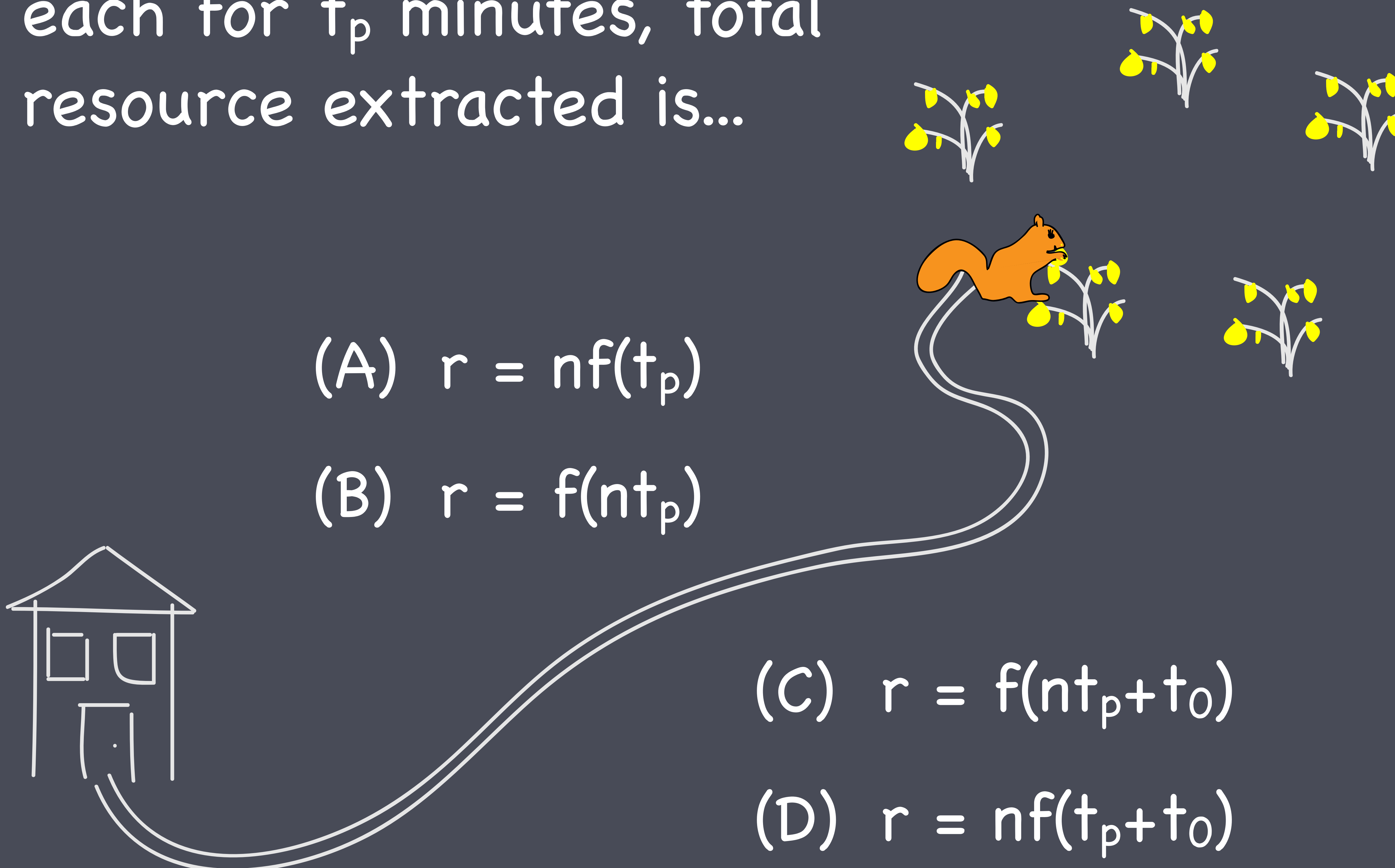

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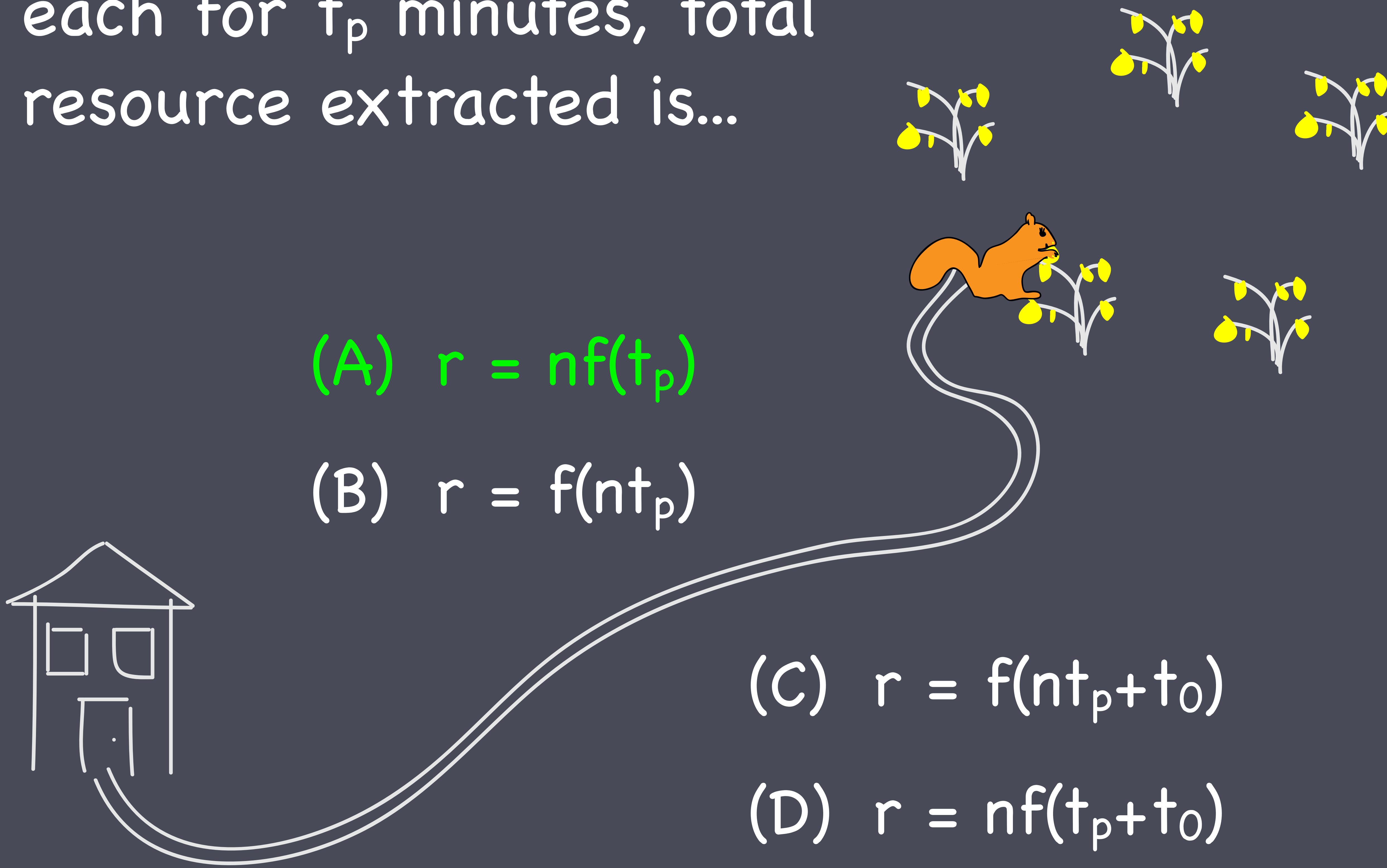
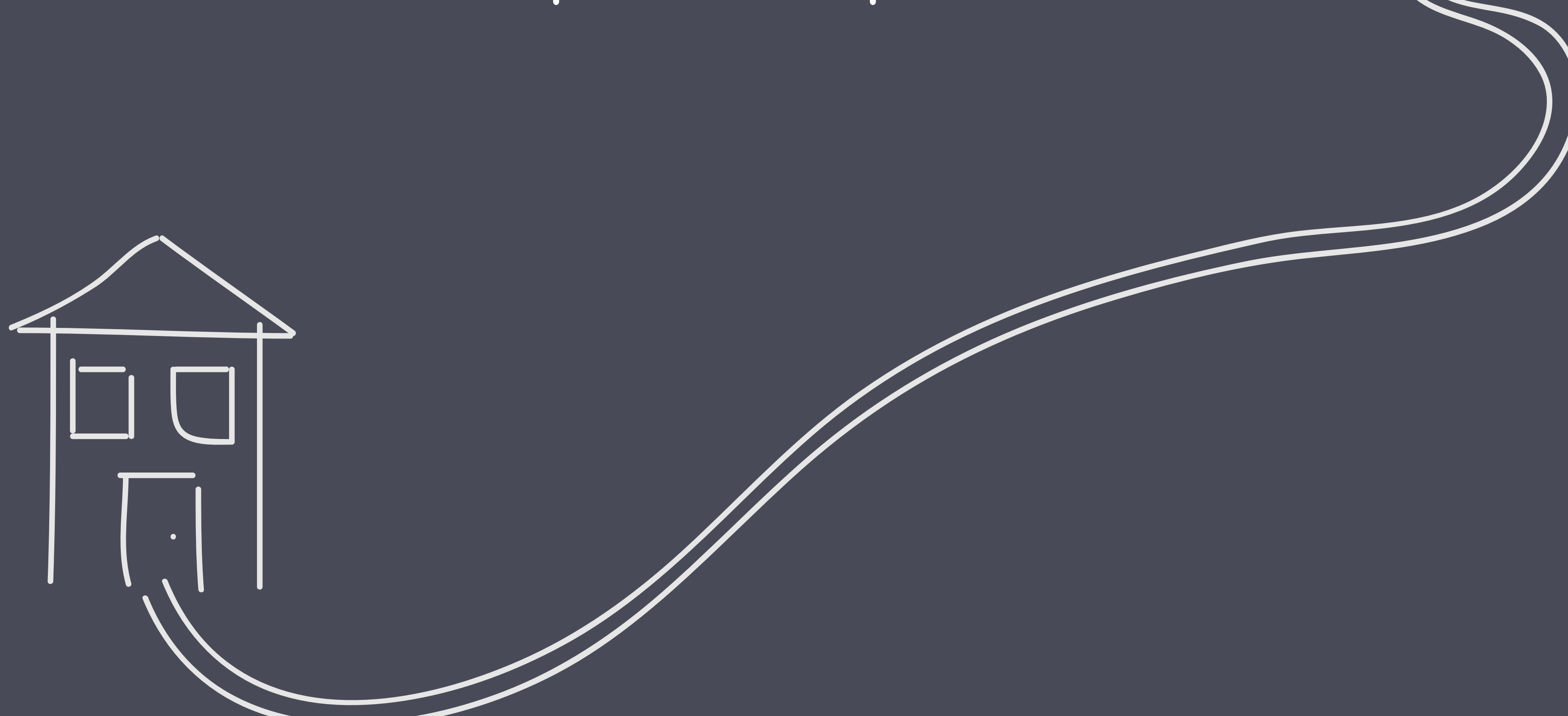


Average rate of resource extraction if t_p is spent in each patch:

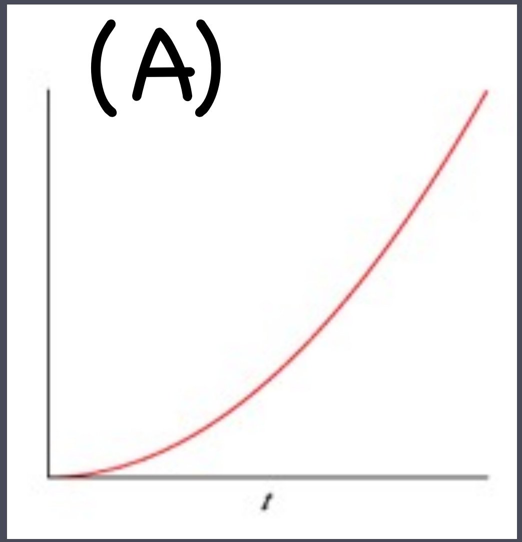
$$R_{avg}(t_p) = \text{total extracted} \;/\; \text{total time}$$

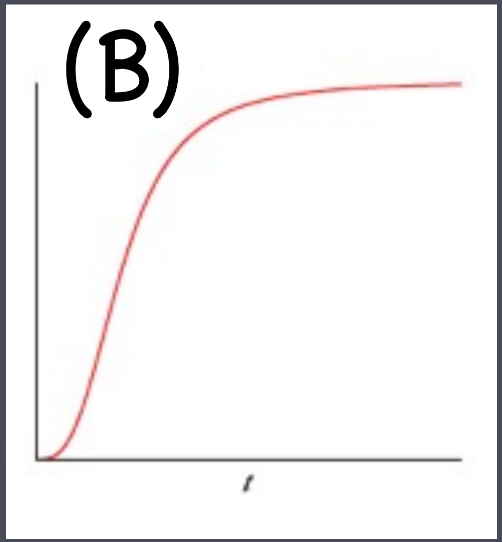
$$= nf(t_p) \;/\; (nt_p + t_0)$$

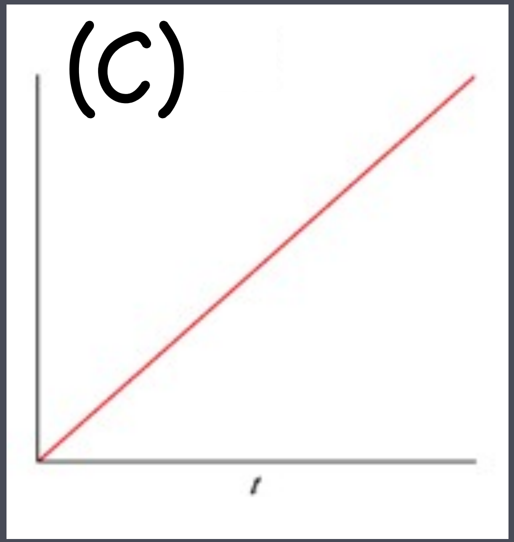


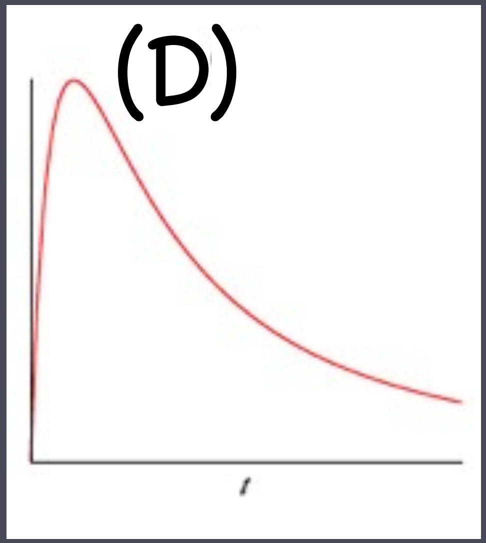
Which of the following graphs matches the given description of f(t)?

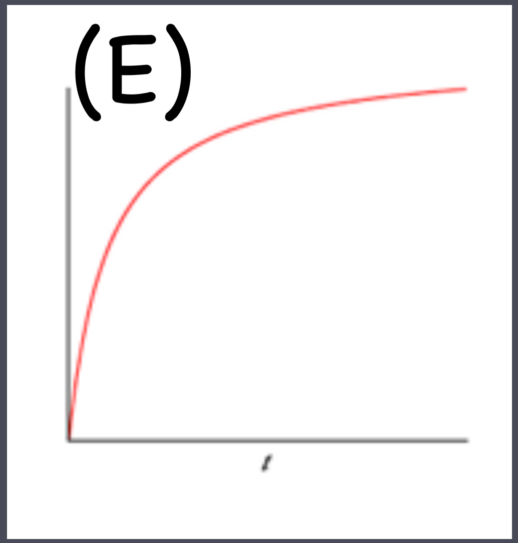
Collection goes well at first but gradually slows down as the resource is depleted.











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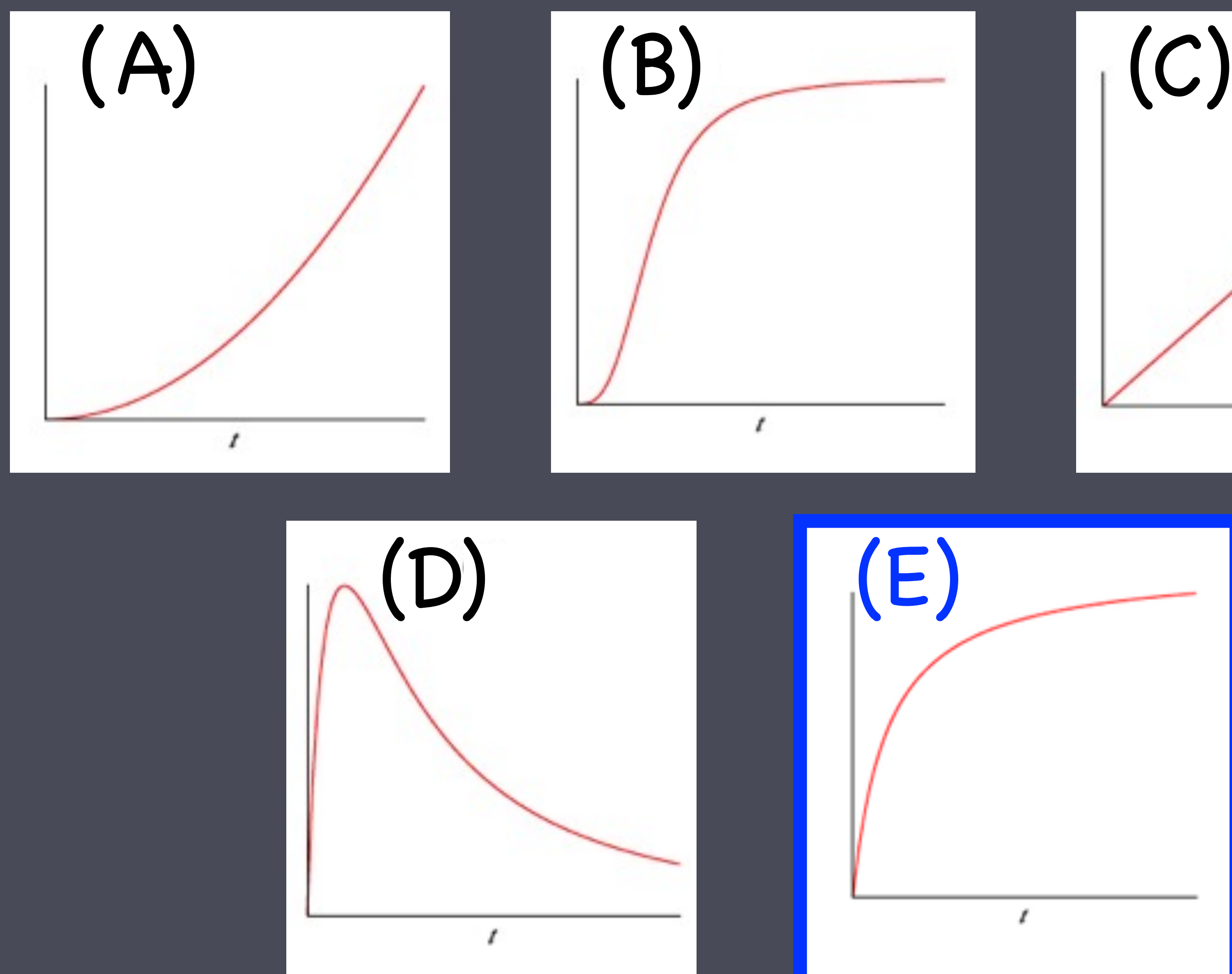

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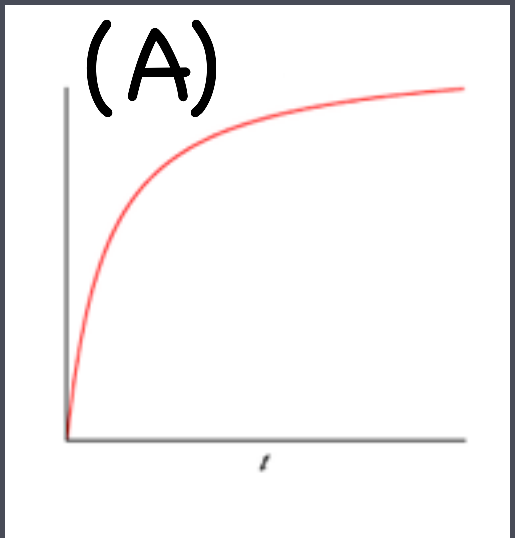

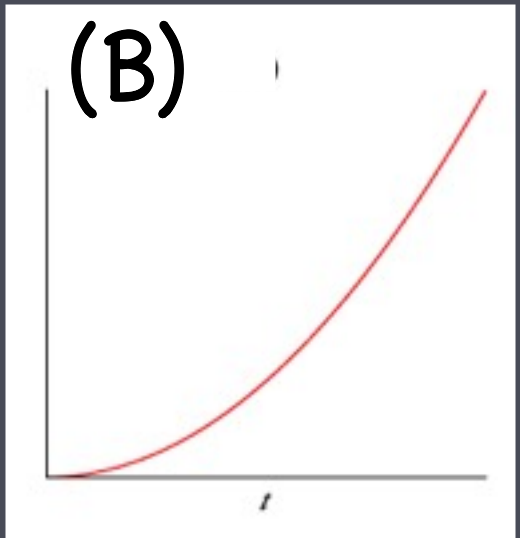

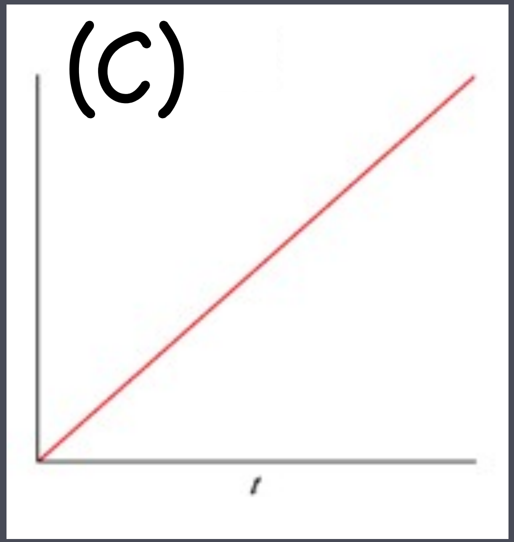

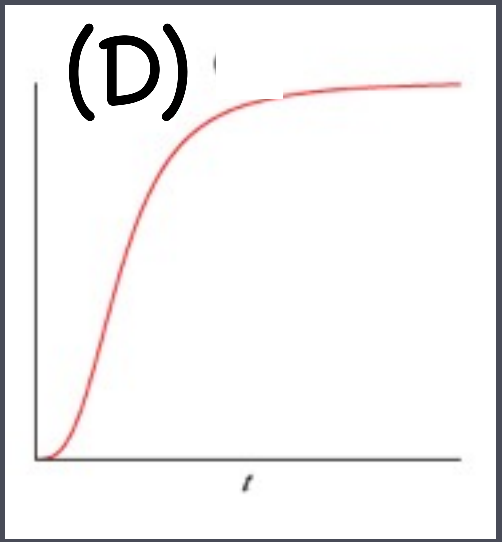

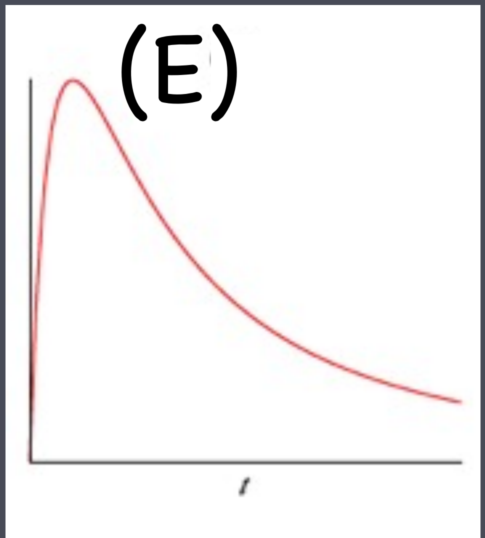

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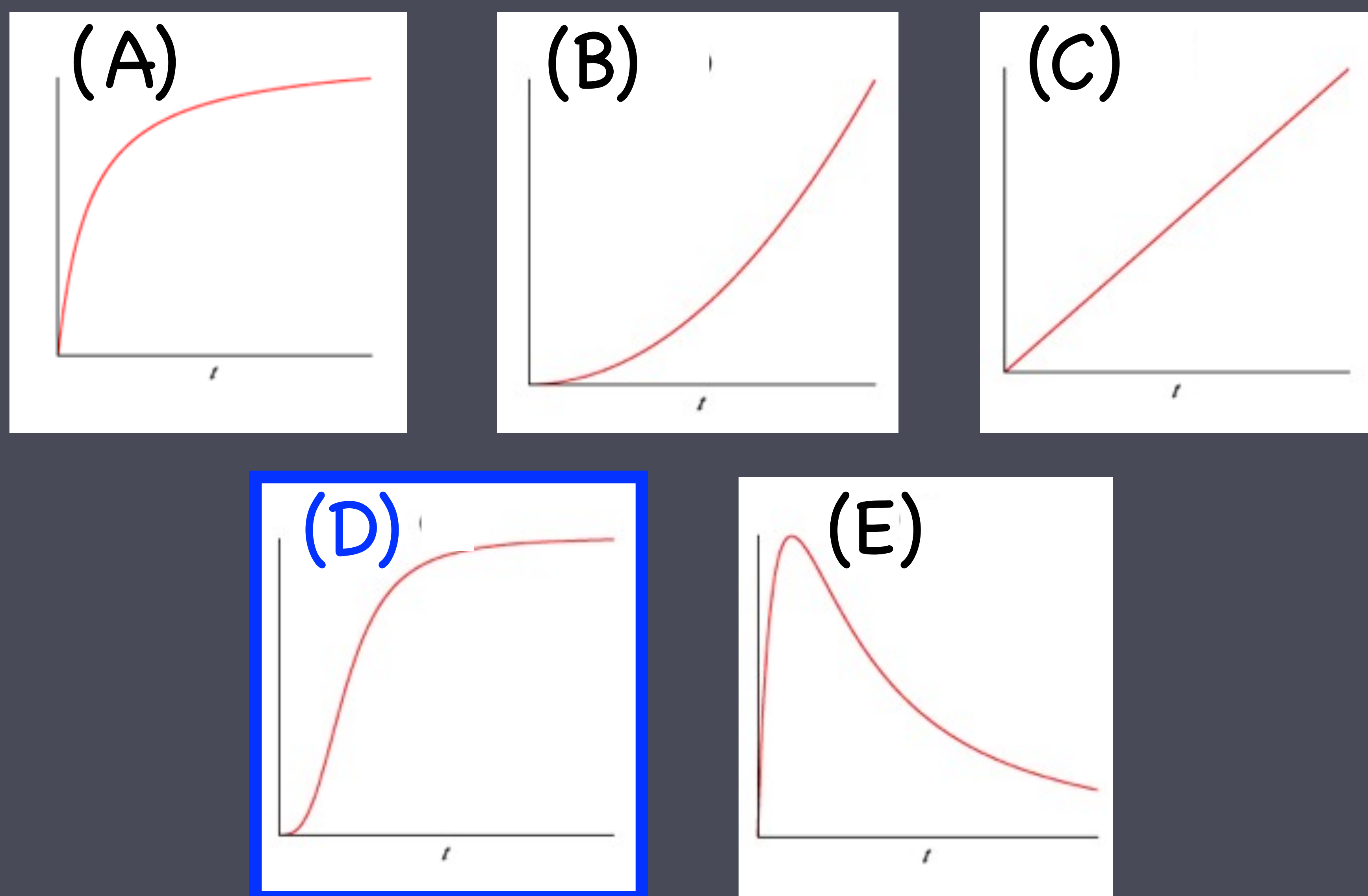
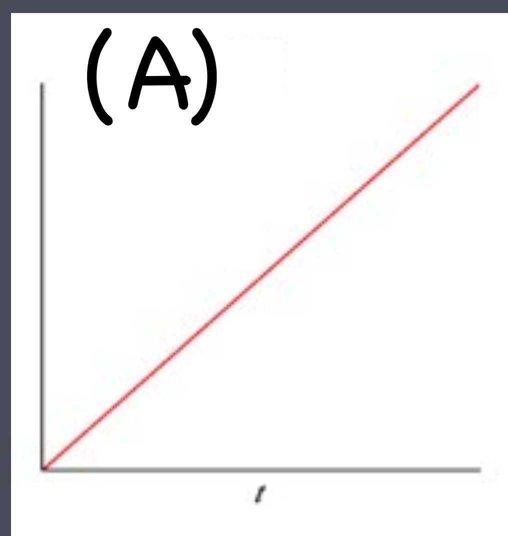
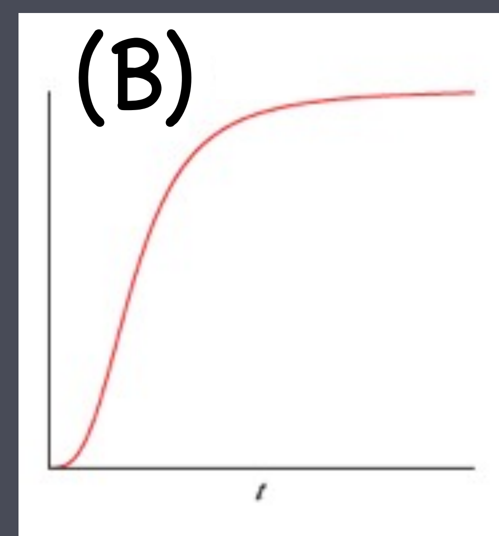
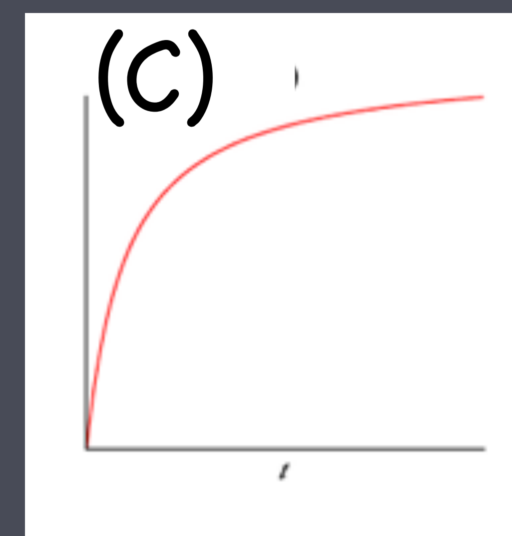


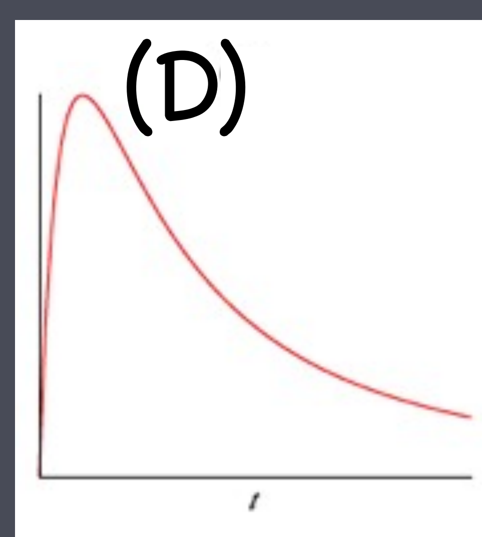
Which of the following graphs matches the given description of f(t)?

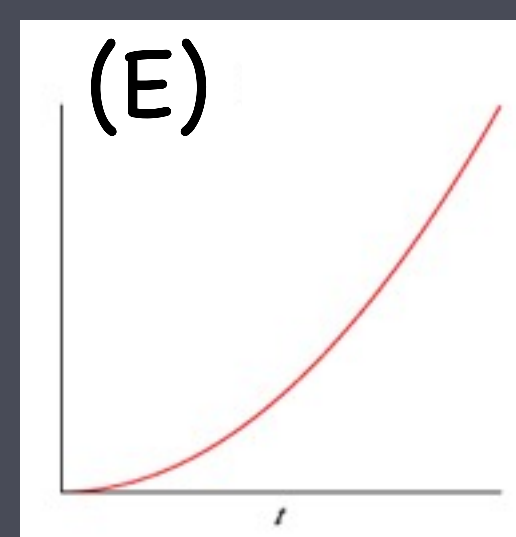
Initially, you collect some nuts but the birds figure out what you're doing and start stealing from you.











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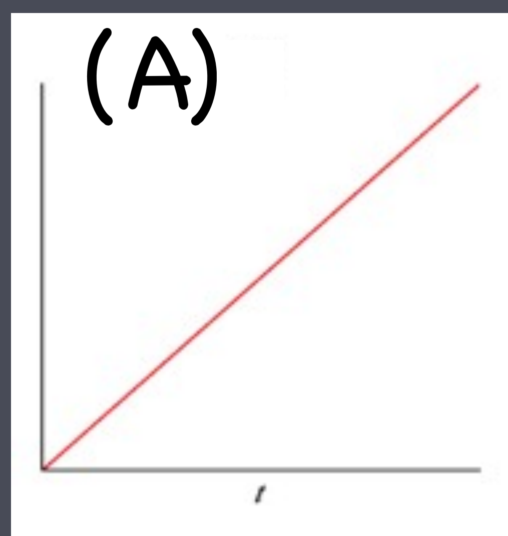
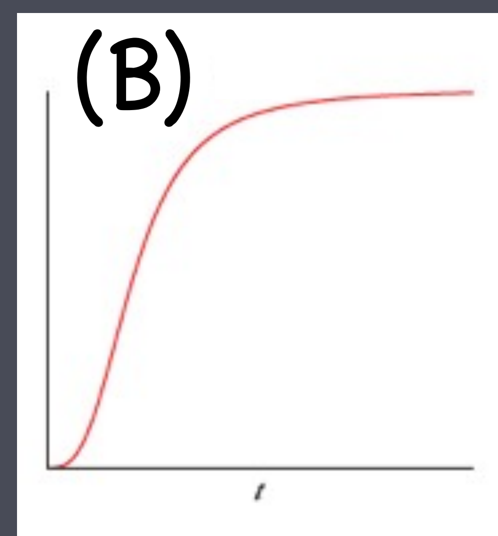
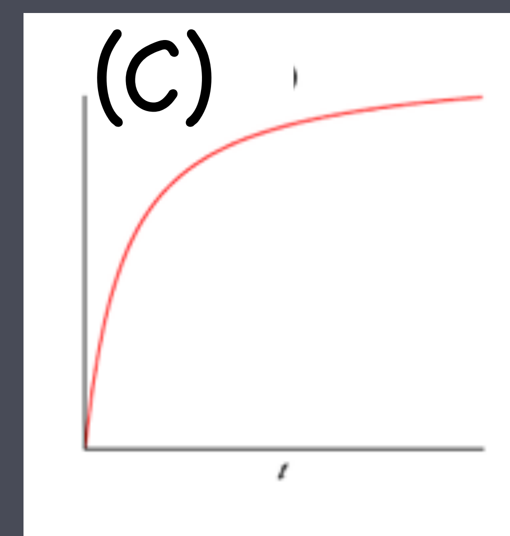
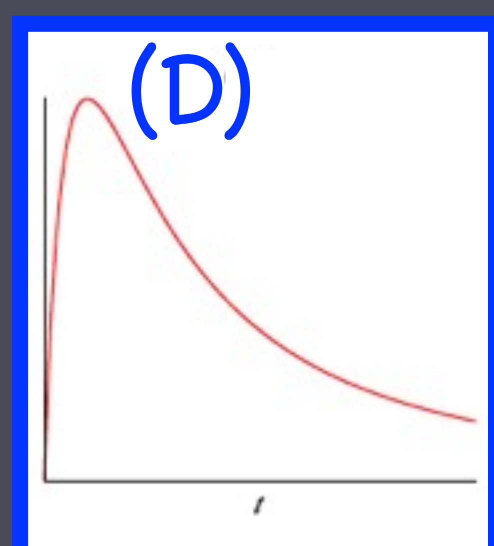
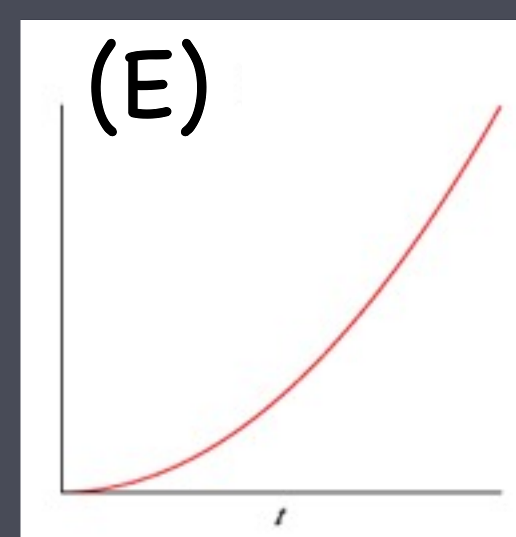




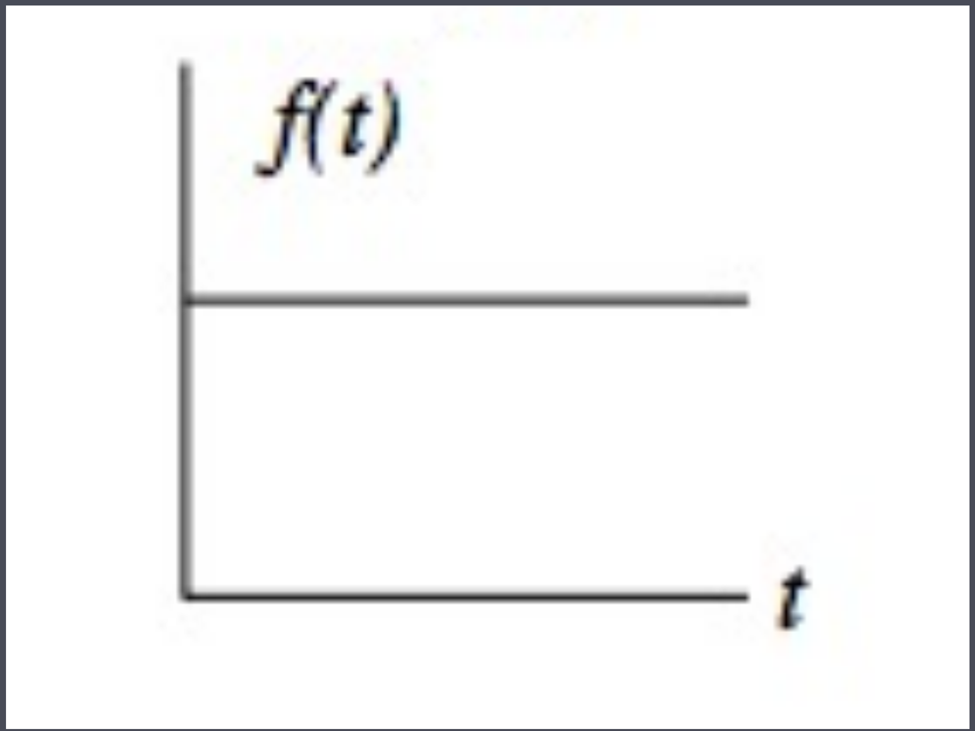






Choose $f(t_p)$=constant=C

Find t_p that maximizes $R_{avg} = nC / (nt_p + t_0)$



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(B) $t_p = 0$

(C) Never leave.

Think and/or sketch before you calculate.

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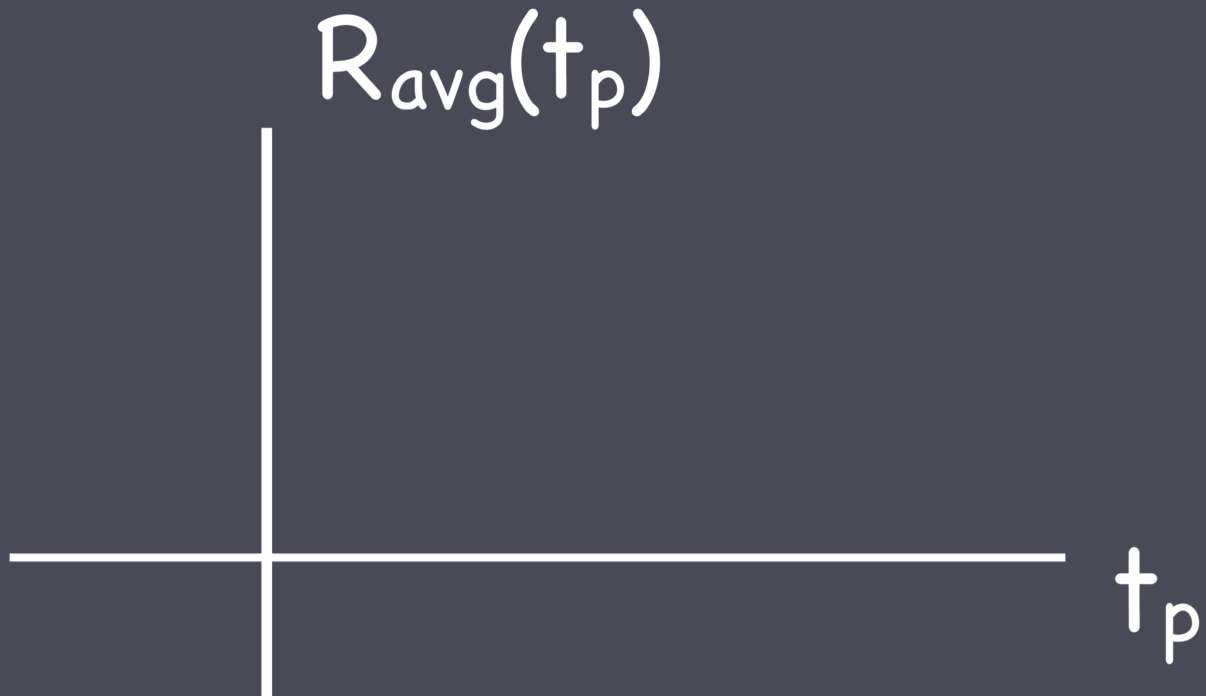

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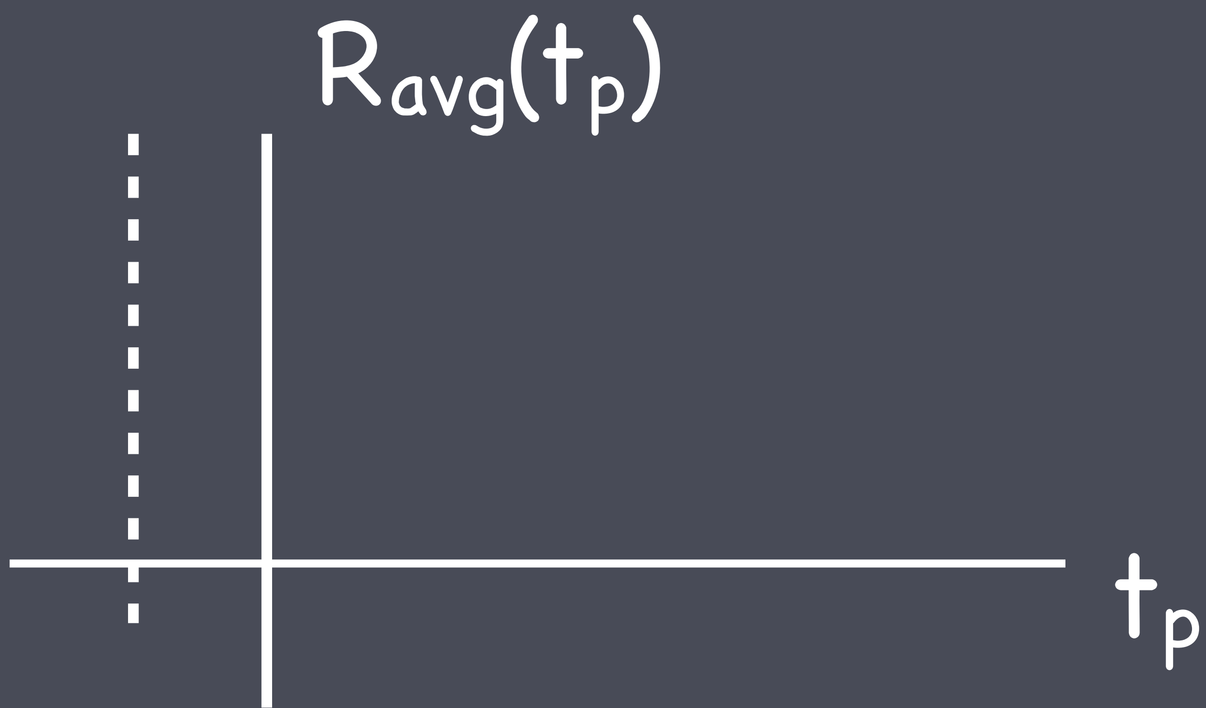

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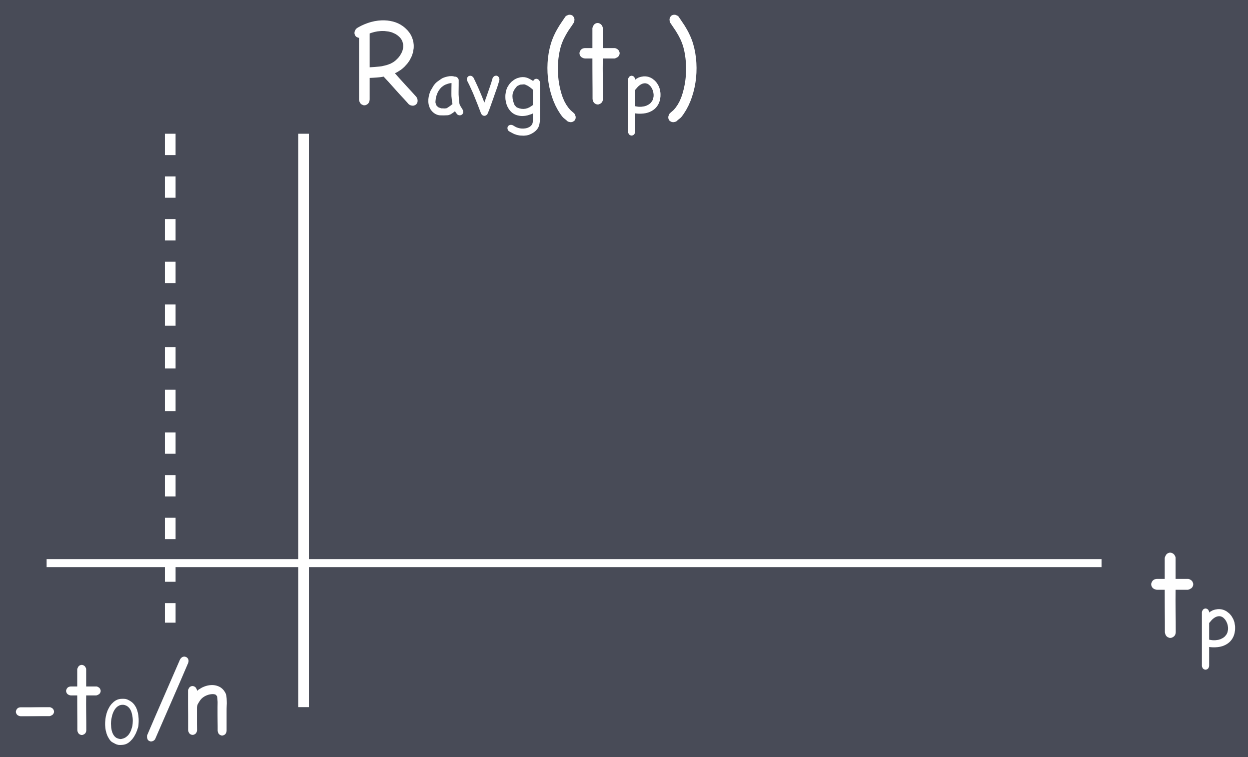

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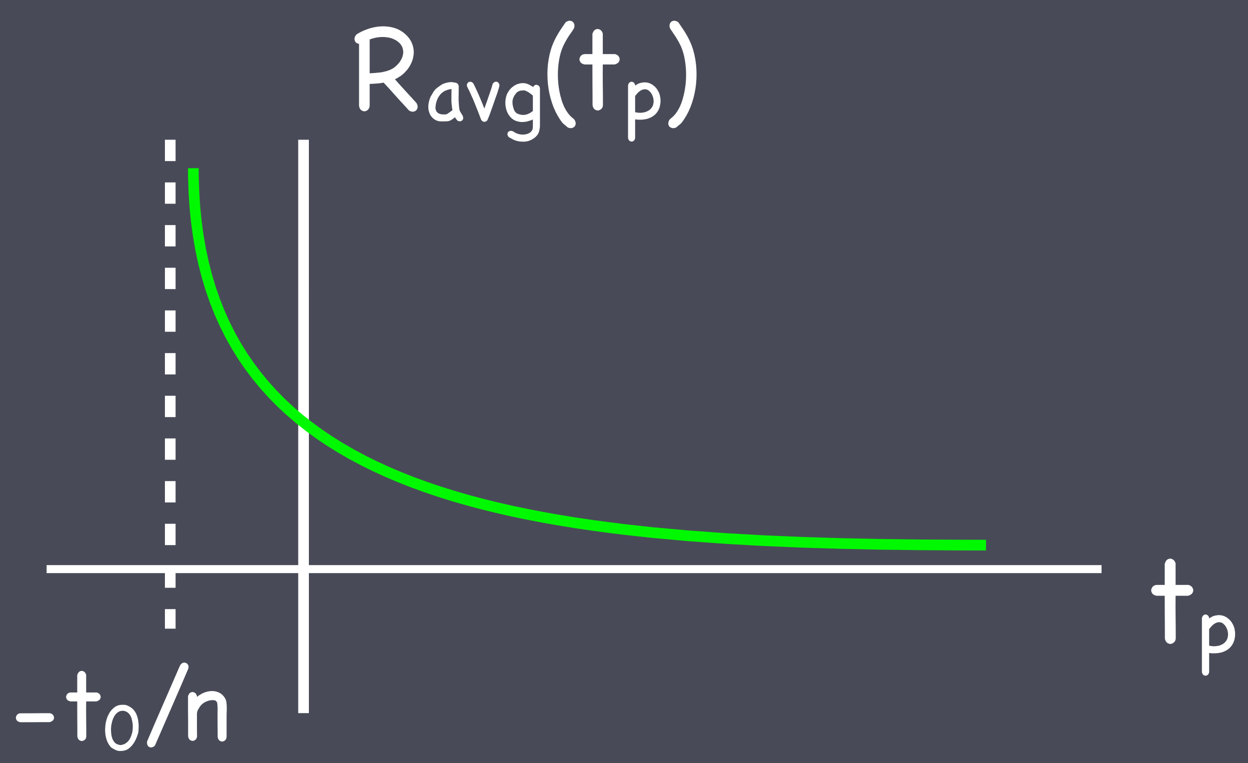

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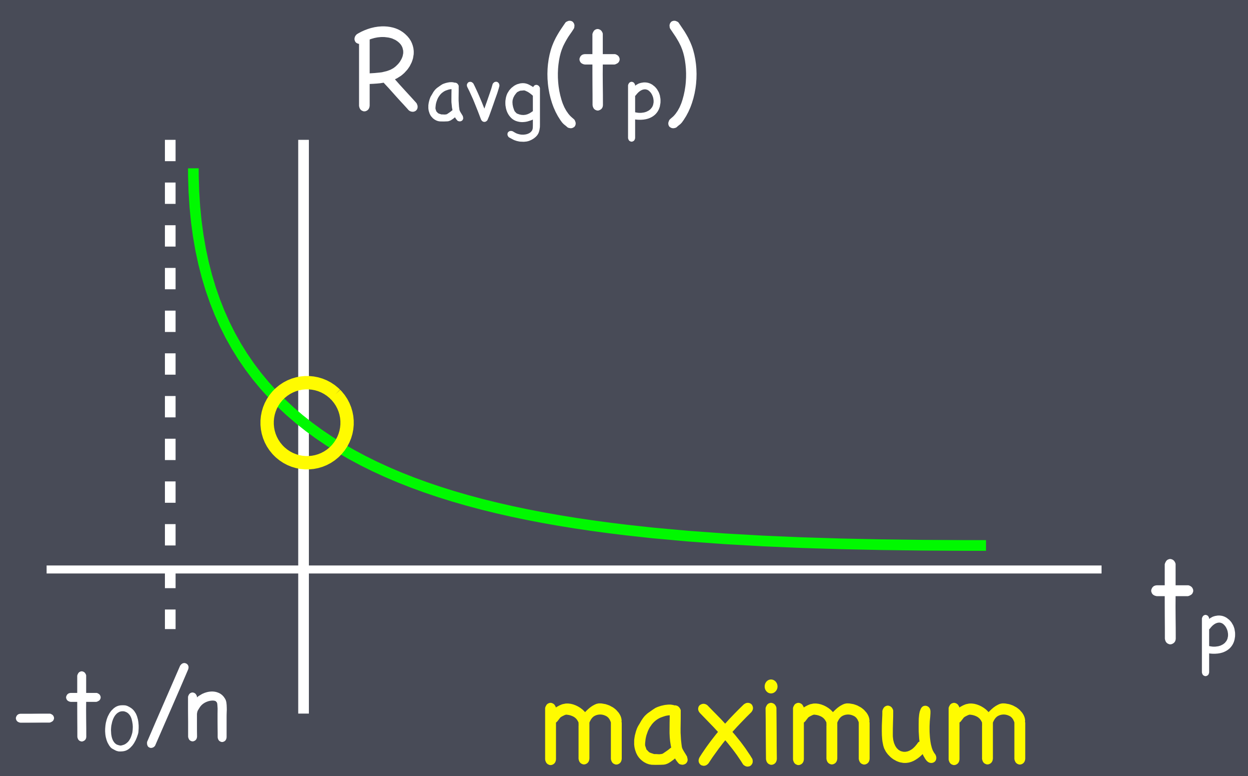

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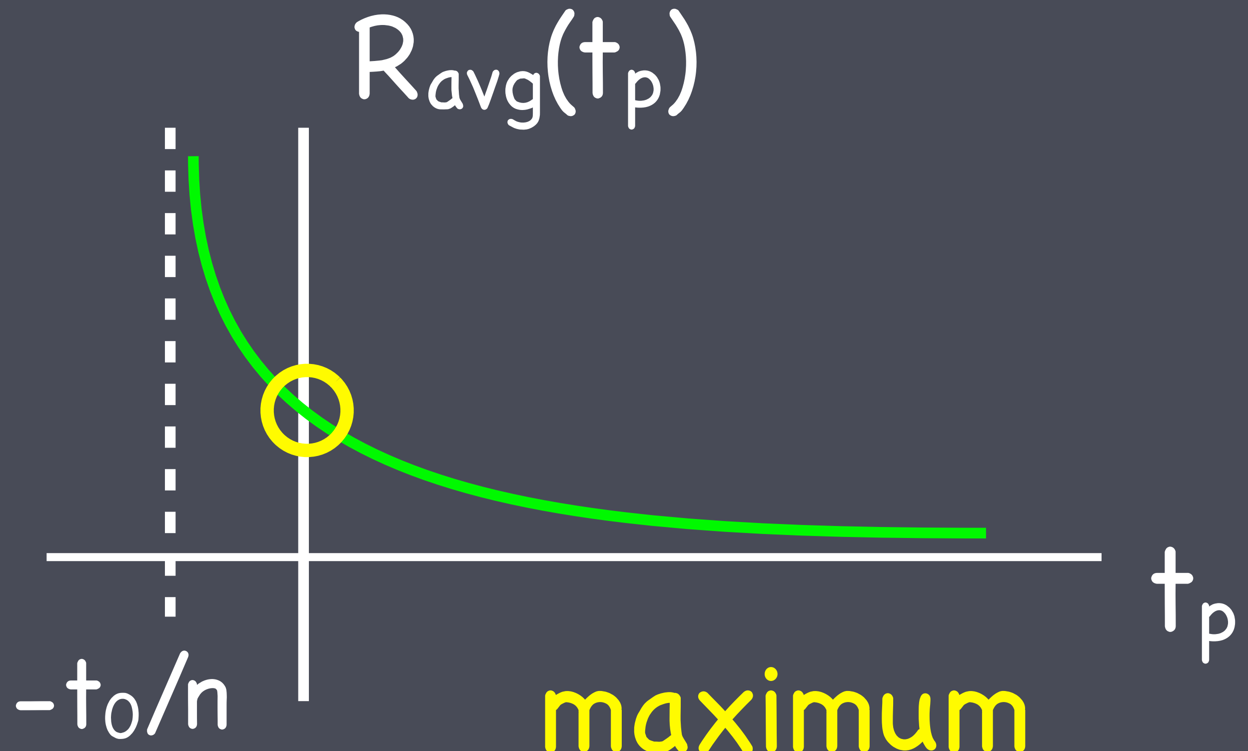

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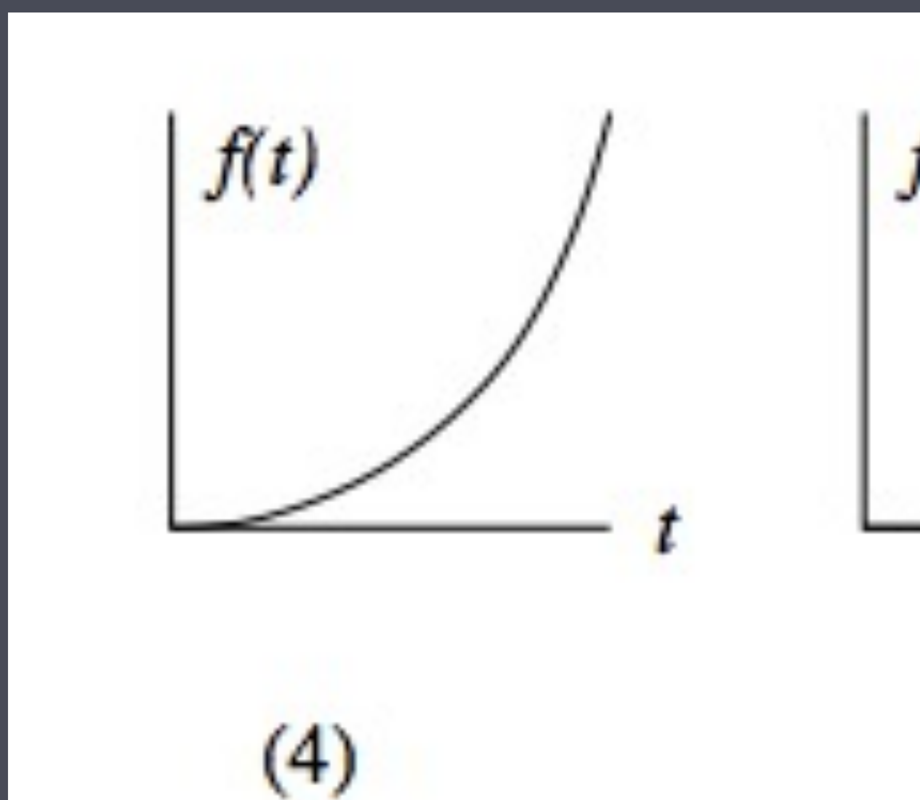
Choose $f(t_p) = t_p^2$

Find t_p that maximizes $R_{avg} = nt_p^2 / (nt_p + t_0)$



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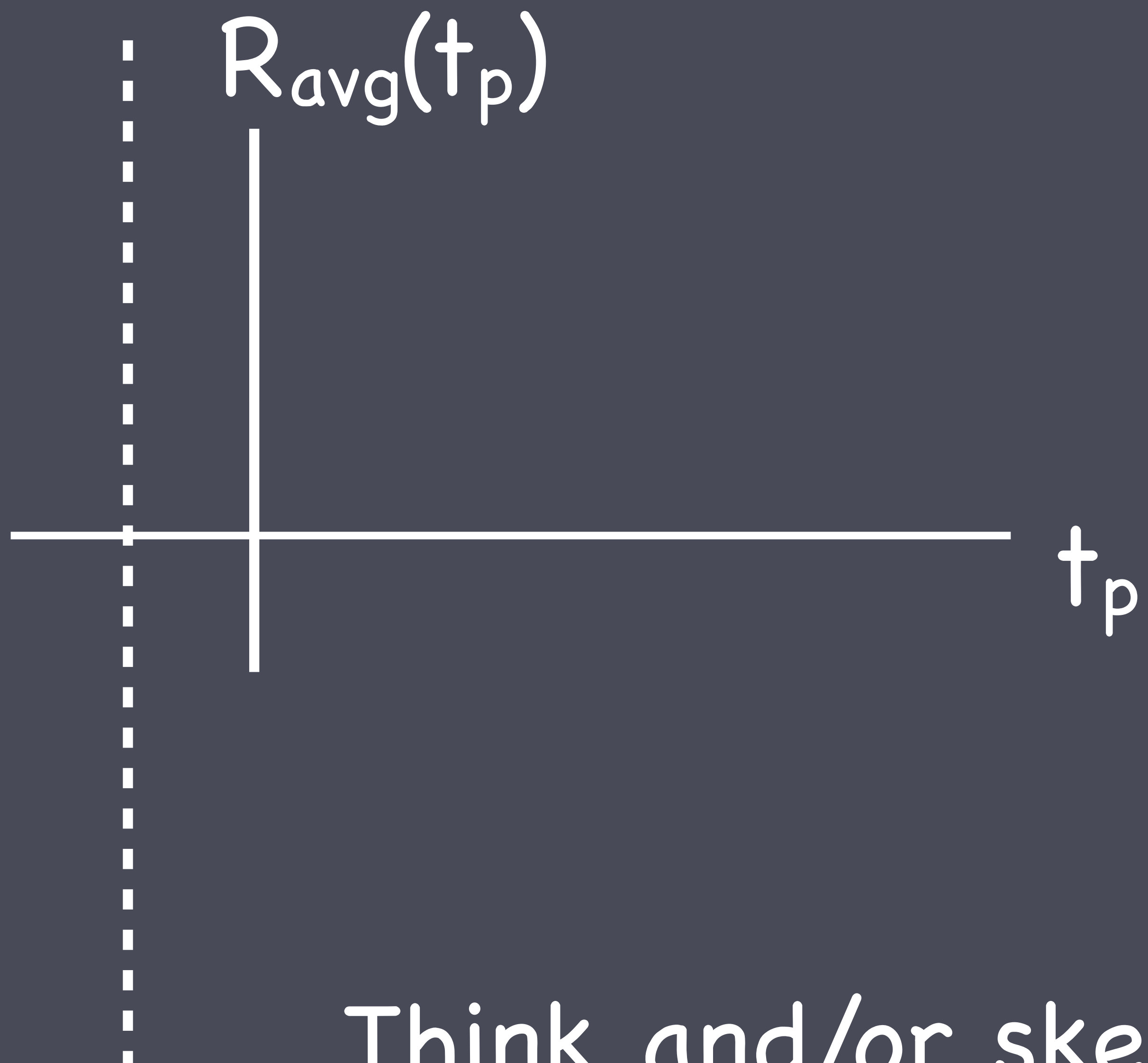

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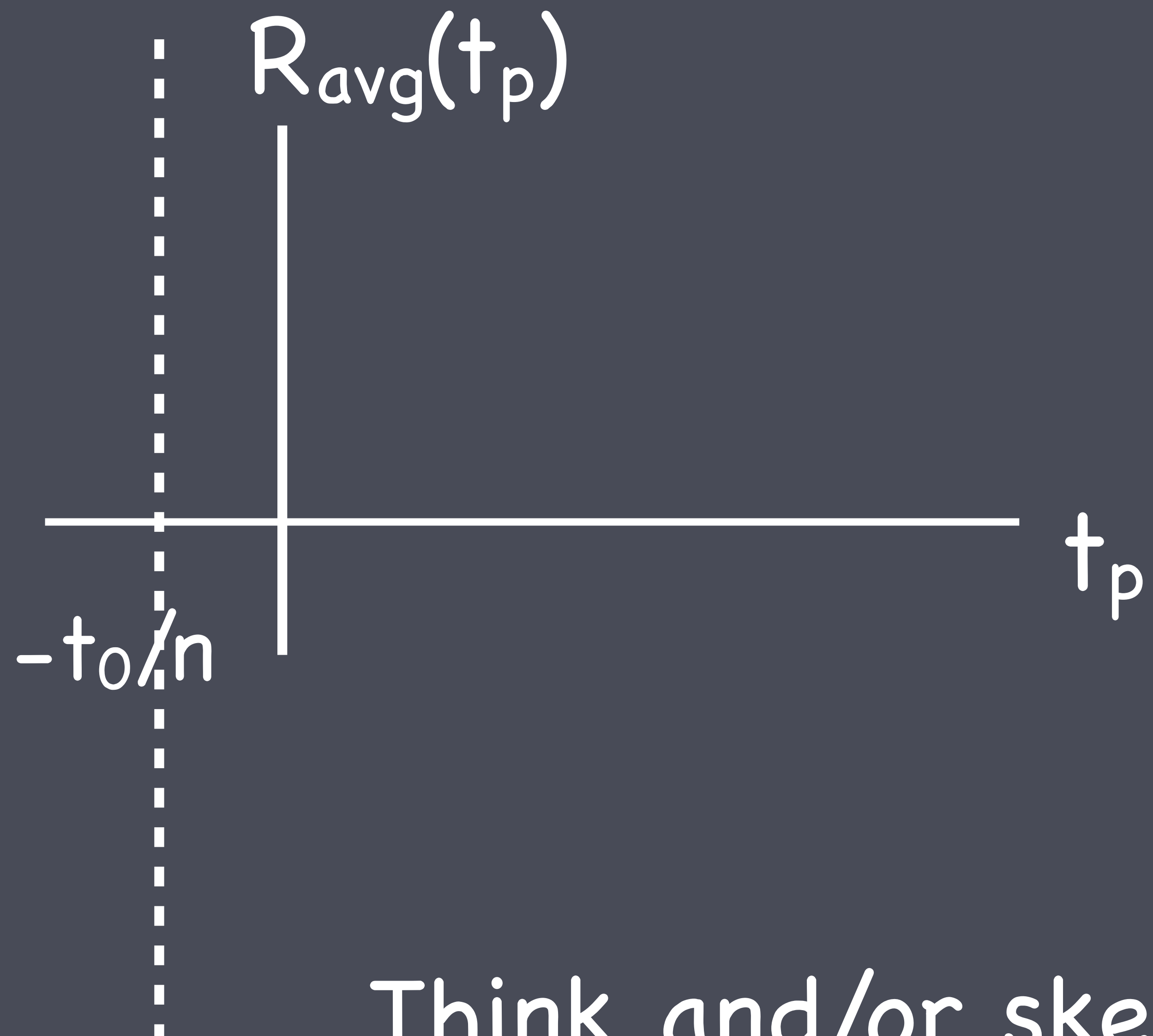

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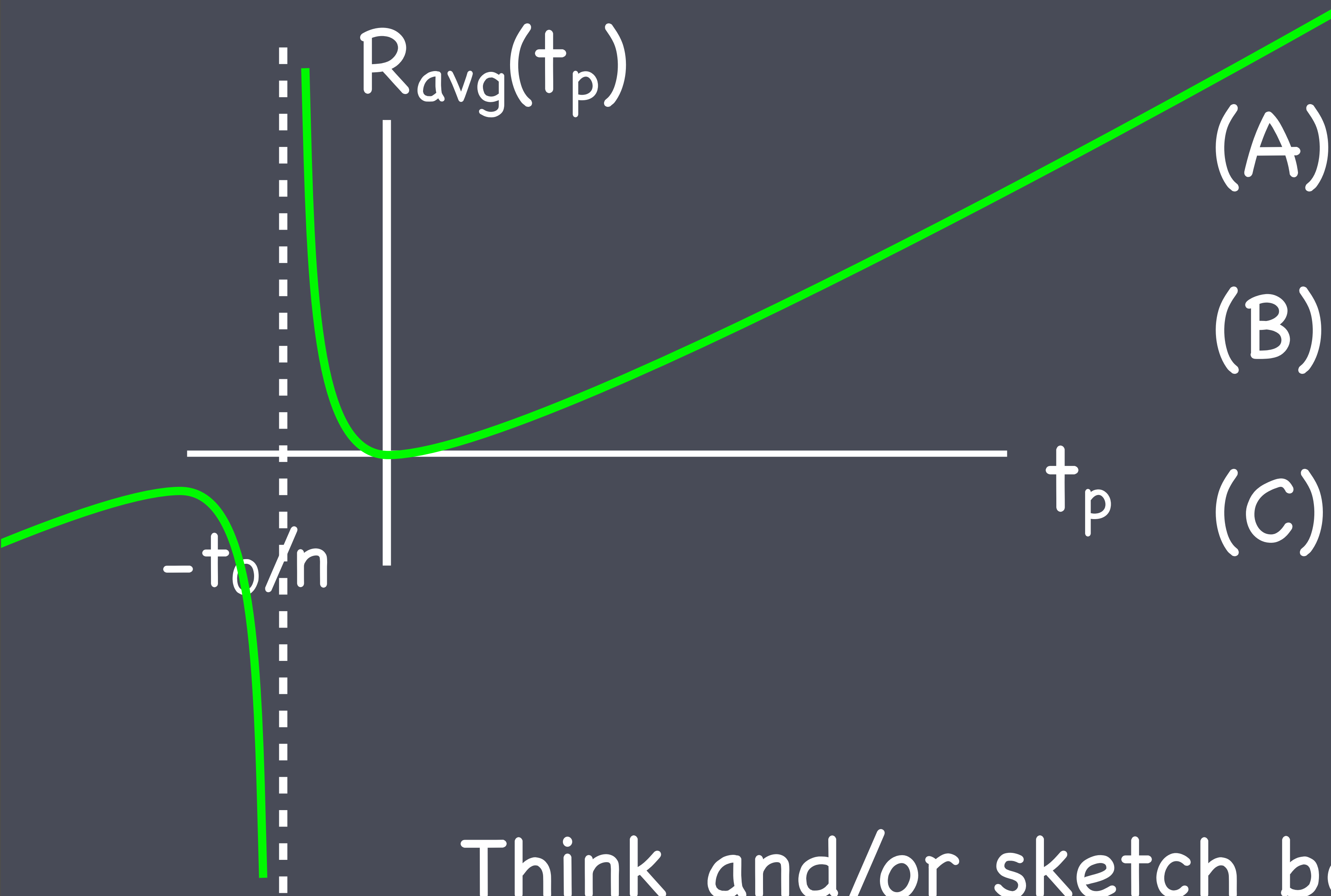

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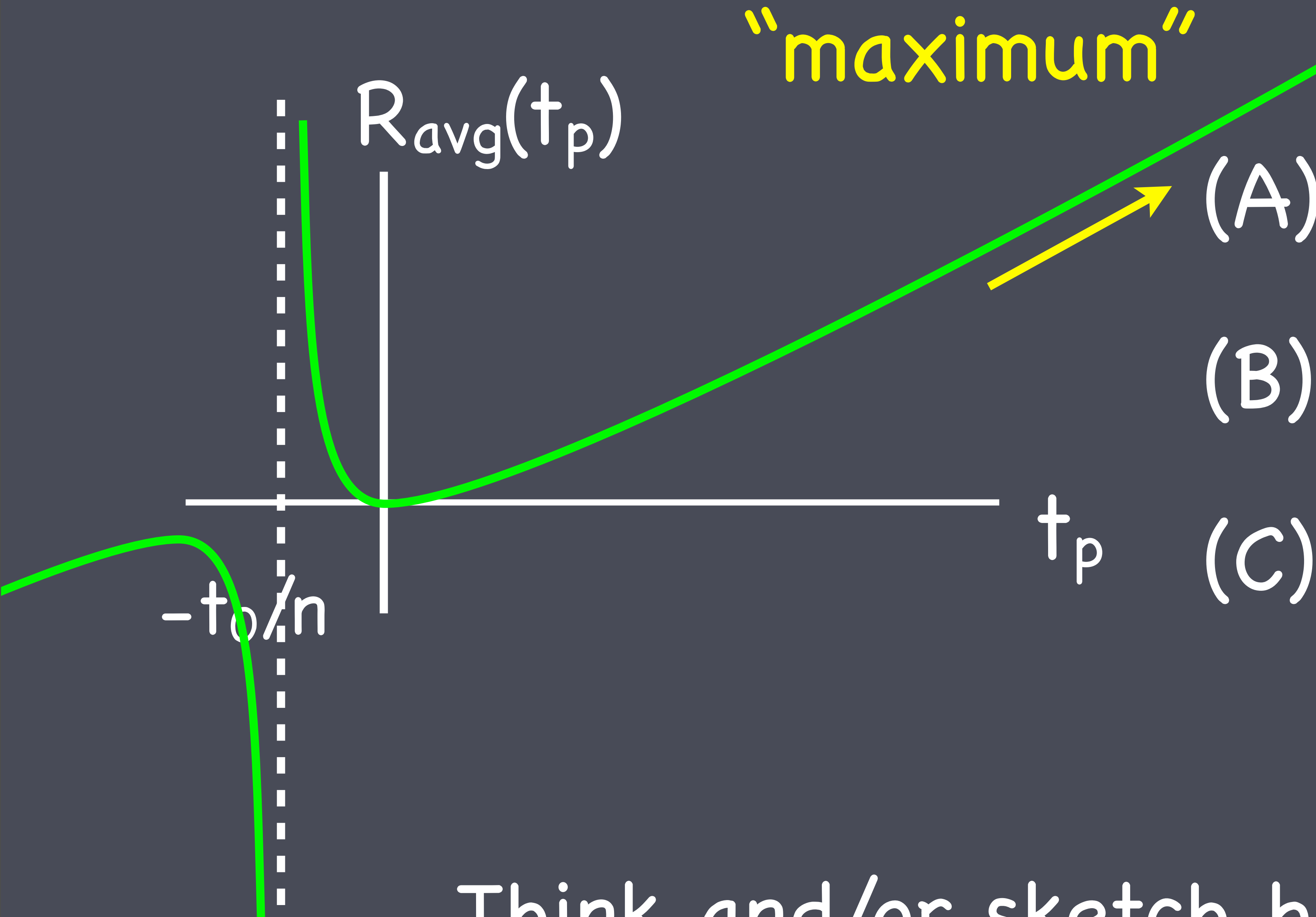

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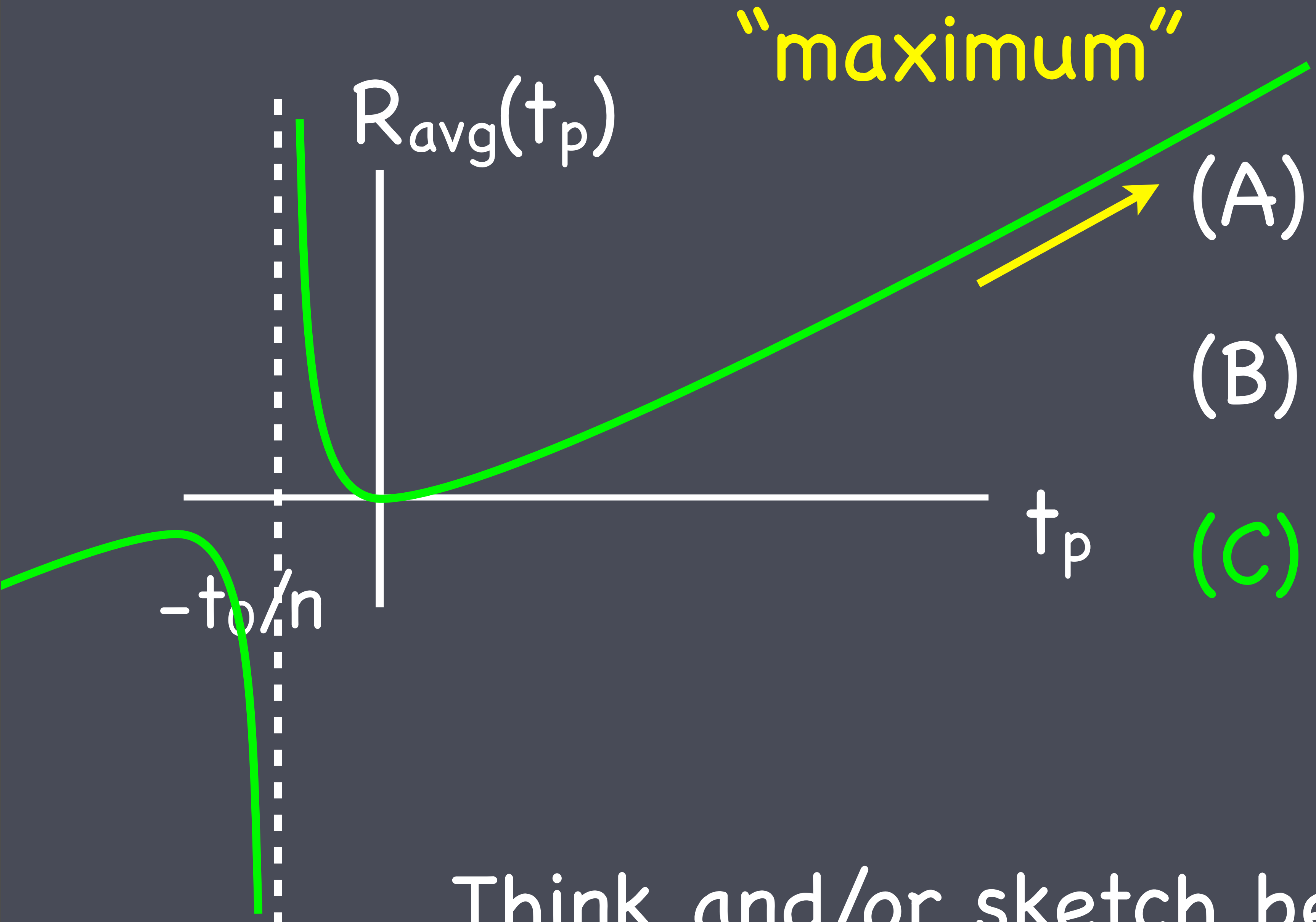

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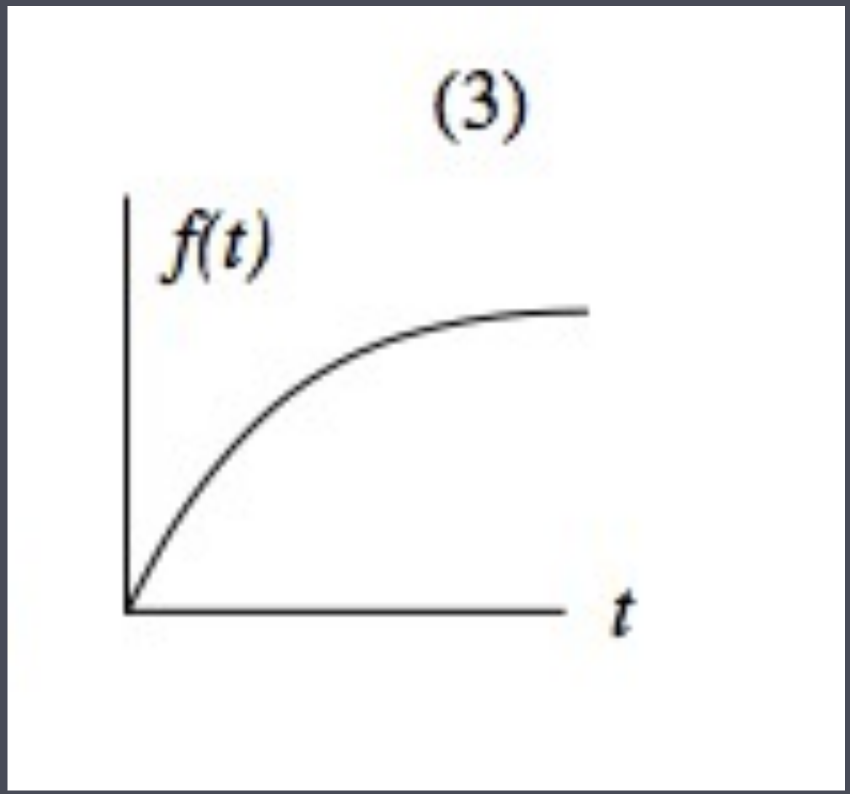
Choose $f(t_p) = t_p/(k+t_p)$

Find t_p that maximizes

$$R_{avg} = nt_p \,/\, (nt_p + t_0)\,(k + t_p)$$



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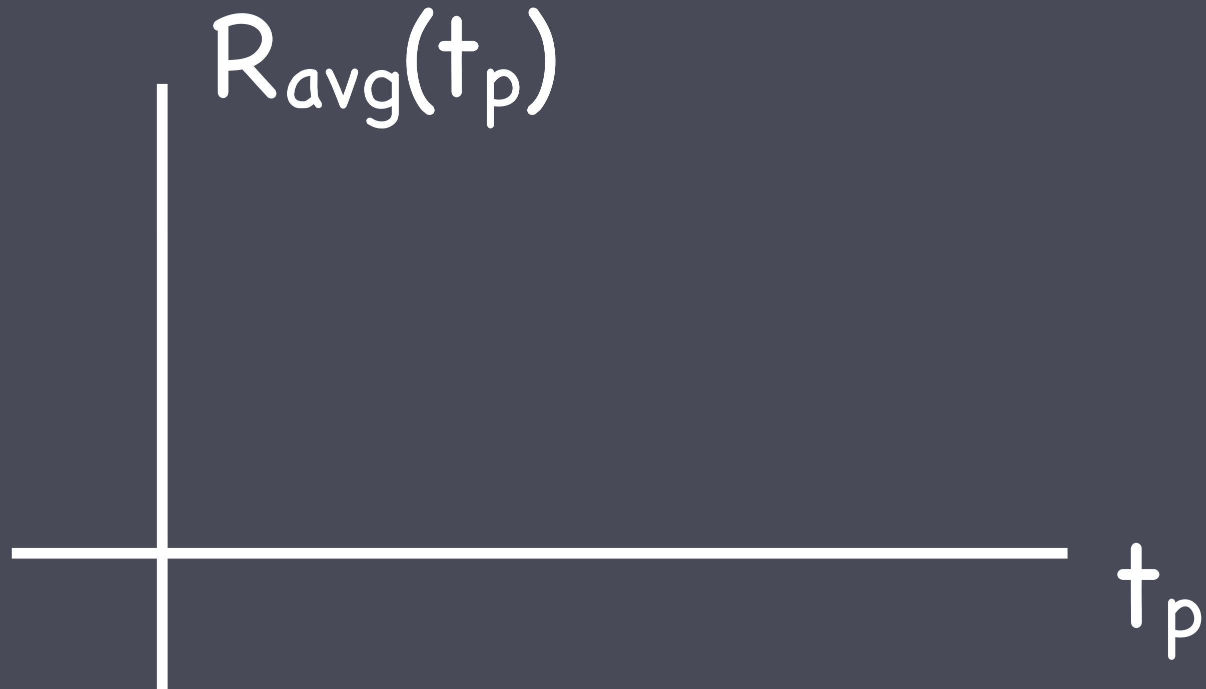

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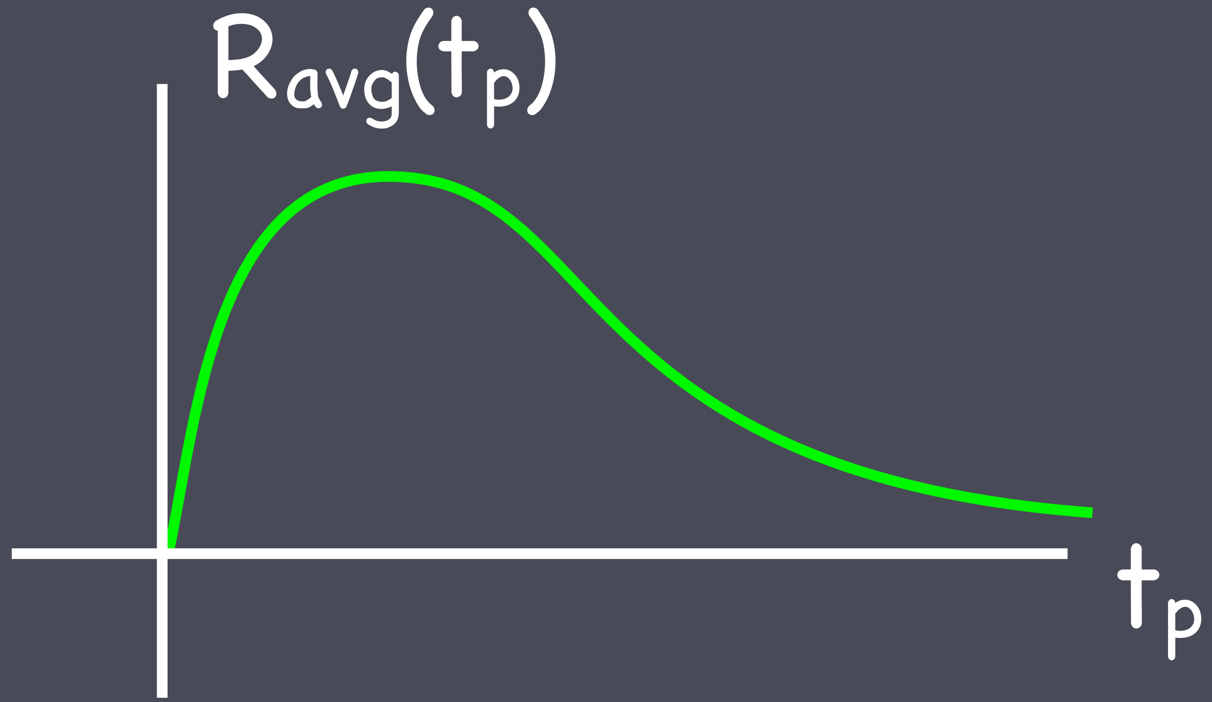

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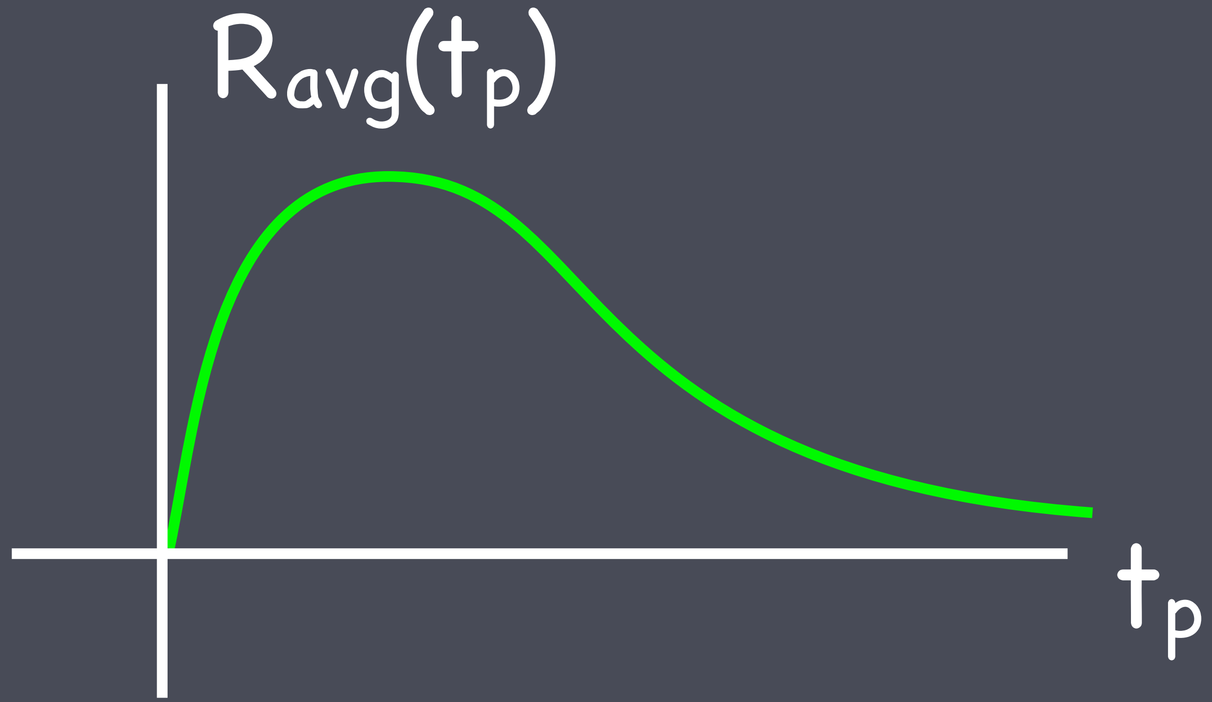
Find t_p that maximizes

$$R_{avg} = nt_p / (nt_p + t_0)(k + t_p)$$



(A) $t_p = 0$

(B) $t_p = sqrt(kt_0/n)$

(C) Never leave.

Think and/or sketch before you calculate.

Summary message:

- It is useful to think about the physical problem and the function being optimized before jumping into calculating derivatives and finding absolute extrema.