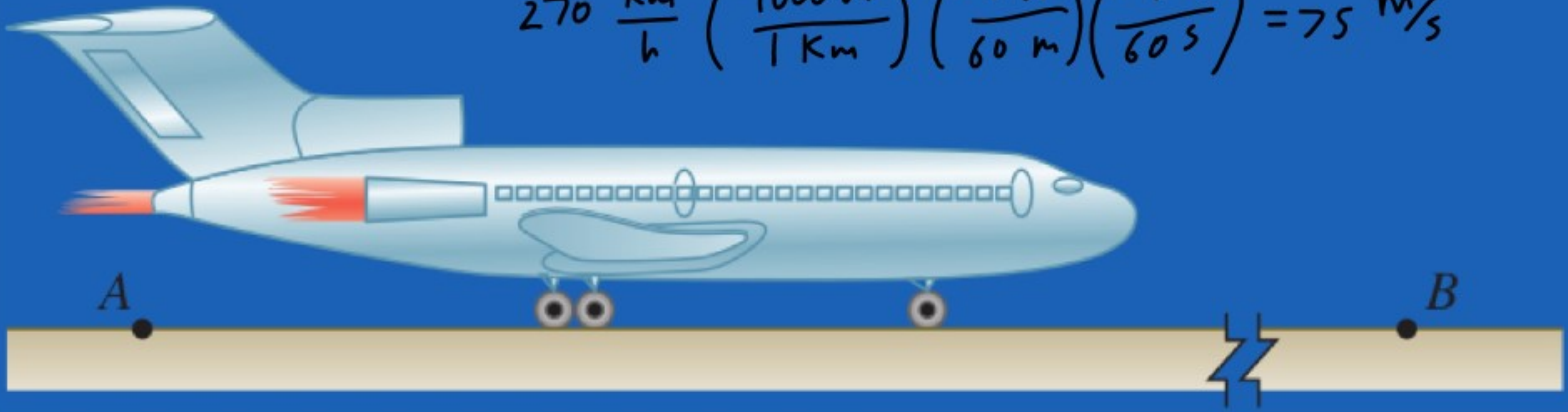
An airplane begins its take-off run at A with zero velocity and a constant acceleration a. Knowing that it becomes airborne 30 s later at B with a take-off velocity of 270 km/h, determine (a) the acceleration a, (b) distance AB.

$$270\ \frac{km}{h}\left(\frac{1000\ m}{1\ Km}\right)\left(\frac{1\ h}{60\ m}\right)\left(\frac{1\ m}{60\ s}\right) = 75\ m/s$$



$$V = V_0 + at$$

$$75\,\mathrm{m/s} = 0\,\mathrm{m/s} + a\,30\,\mathrm{s}$$

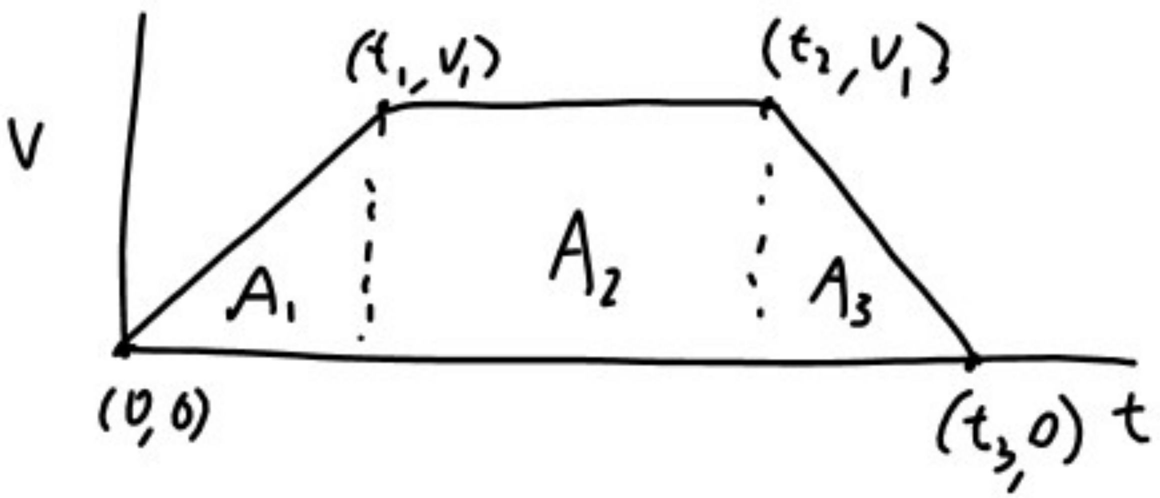
$$\frac{75\,\mathrm{m/s}}{30\,\mathrm{s}} = \boxed{2.5\,\mathrm{m/s^2} = a}$$

$$x = x_0 + V_0 t + \frac{1}{2}at^2$$

$$= 0 + 0\,(30\,\mathrm{s}) + \frac{1}{2}\,2.5\,\mathrm{m/s^2}\,(30\,\mathrm{s})^2$$

$$= 1125\,\frac{\mathrm{m}\,\mathrm{s}^2}{\mathrm{s}^2} = 1125\,\mathrm{m} = \boxed{1.125\,\mathrm{km}}$$

Graphical Methods



if $x = x_0$ at $t = 0$

at t_1 $\quad x = x_0 + \dfrac{t_1 v_1}{2}$

at t_2 $\quad x = x_0 + \dfrac{t_1 v_1}{2} + v_1(t_2 - t_1)$

from 0 to t_1

$a = \dfrac{v_1}{t_1}$

from t_1 to t_2

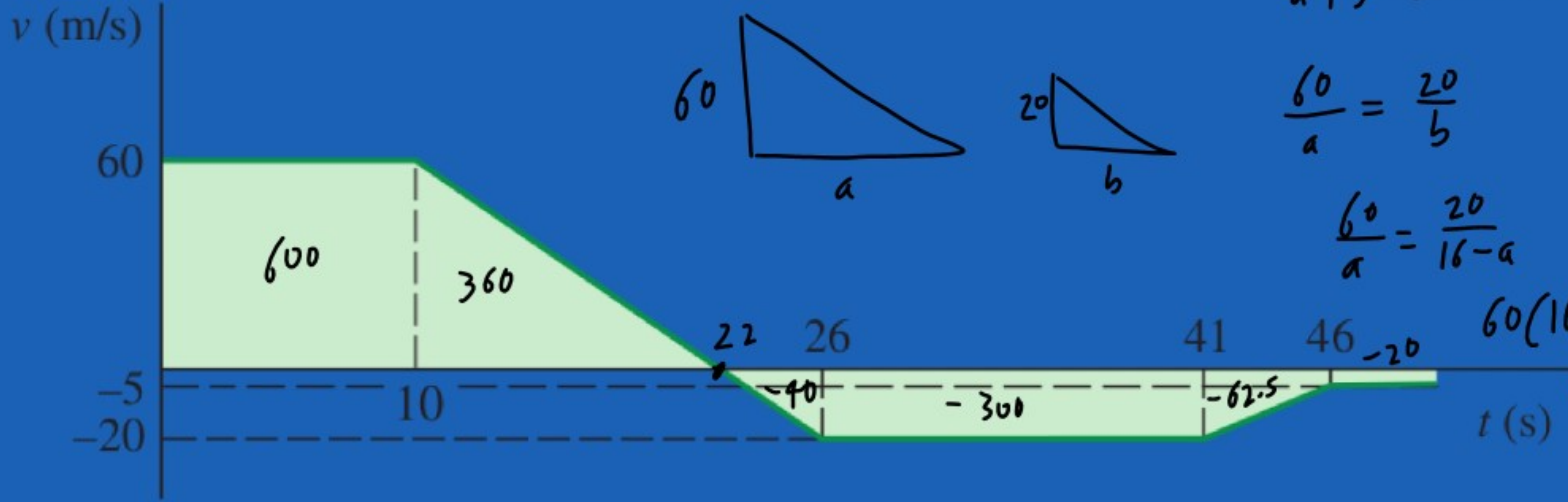
$a = 0$

$$A = \int_{x_1}^{x_2} f(x)\,dx$$

if we have	area under curve	slope
plot of x	n/a	V
plot of V	Δx	a
plot of a	ΔV	n/a

$$\frac{dx}{dt} = V$$

A particle moves in a straight line with the velocity shown in the figure. Knowing that $x = -540$ m at $t = 0$, (*a*) construct the a–t and x–t curves for $0 < t < 50$ s, and determine (*b*) the total distance traveled by the particle when $t = 50$ s, (*c*) the two times at which $x = 0$.



$a + b = 26 - 10 = 16$

$b = 16 - a$

$\frac{60}{a} = \frac{20}{b}$

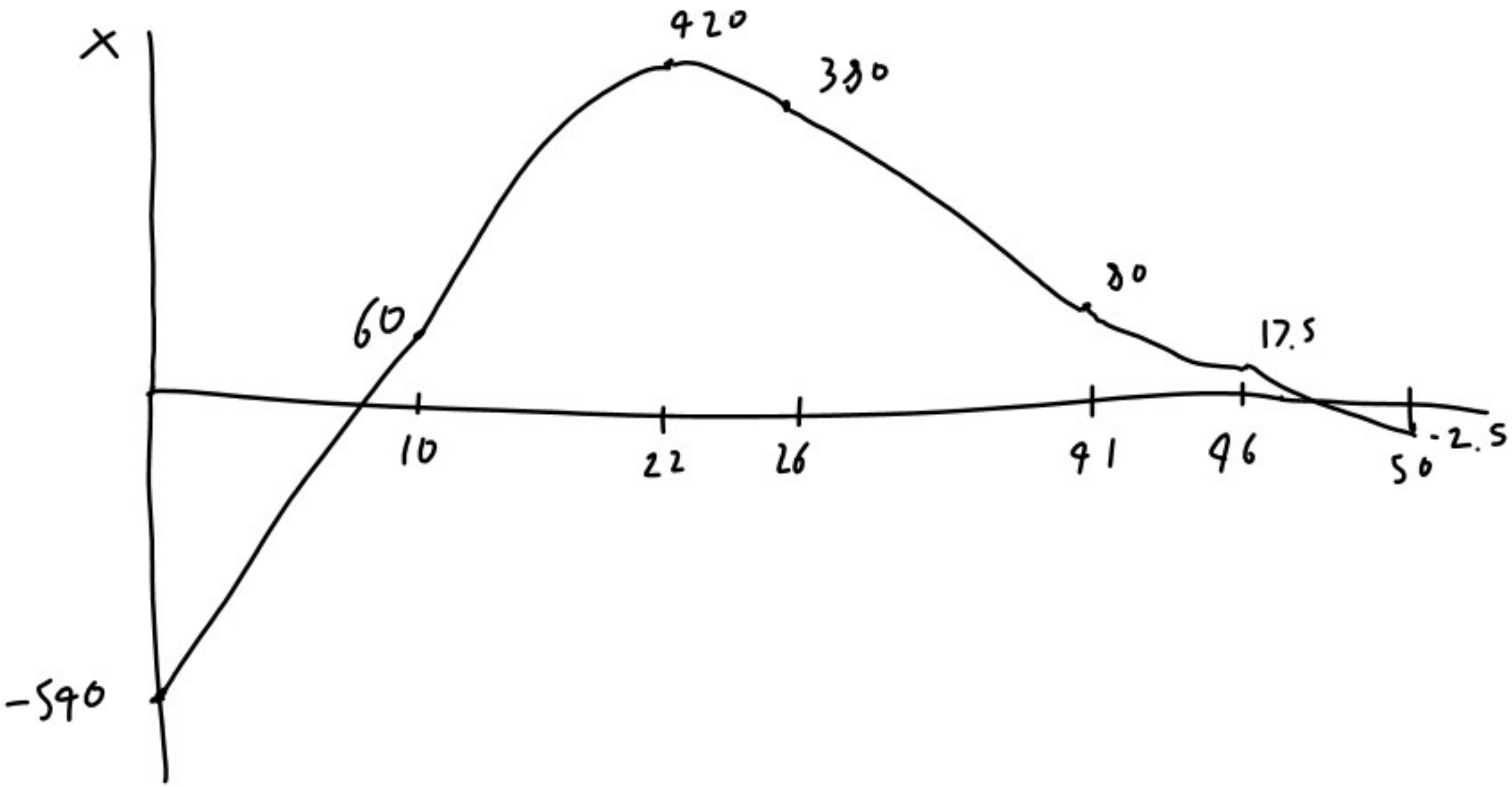
$\frac{60}{a} = \frac{20}{16-a}$

$60(16-a) = 20a$

$960 - 60a = 20a$

$960 = 80a$

$a = 12$


x
420
380
80
60
17.5
-2.5
-540
10
22
26
41
46
50