The 5 Equations of Constant Acceleration

1. $a = \frac{v_2 - v_1}{t}$

Which can also be written as

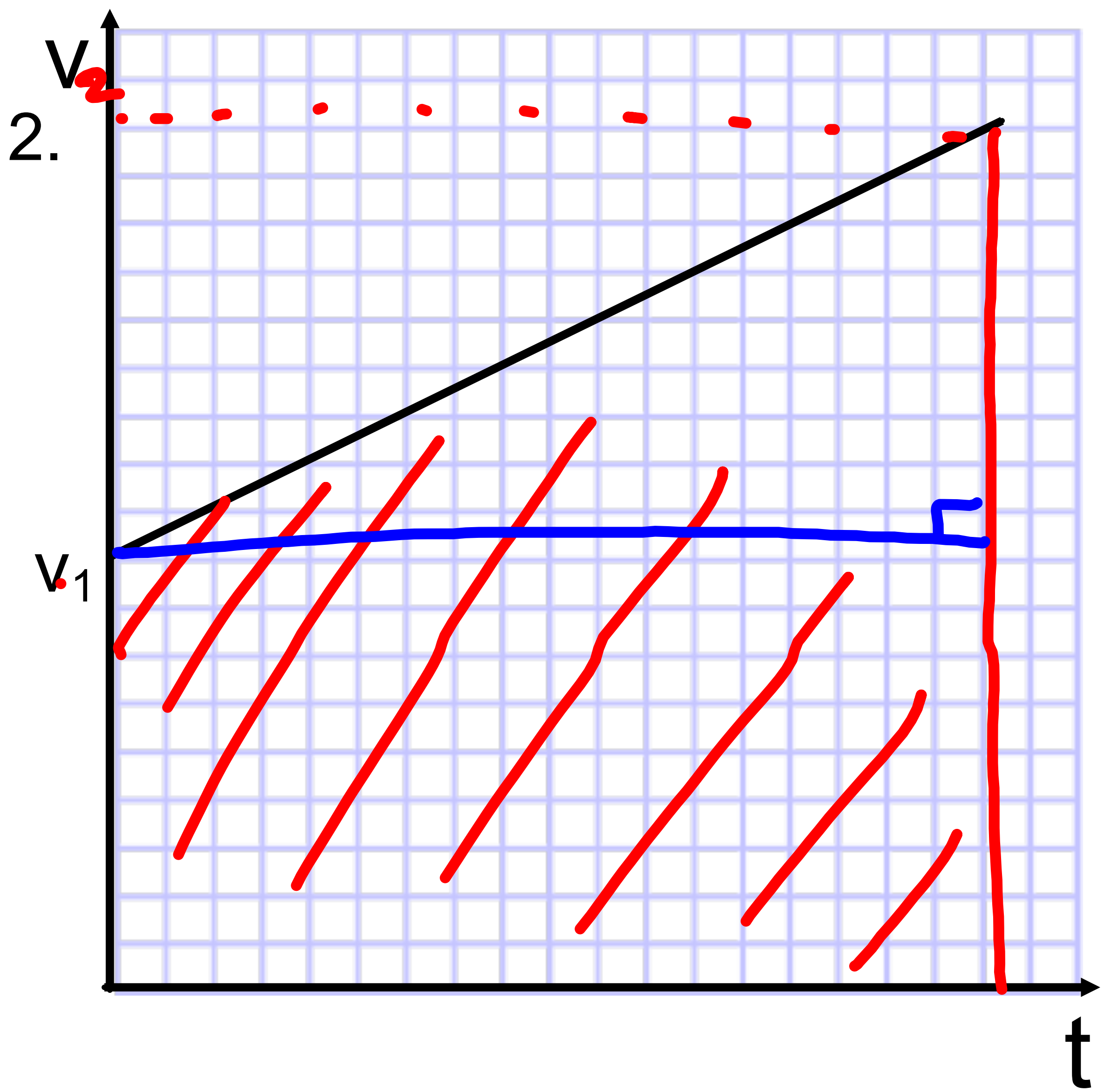
$v_2 - v_1 = at$

$v_2 = v_1 + at$

$v_1 = v_2 - at$

$t = \frac{v_2 - v_1}{a}$

2.



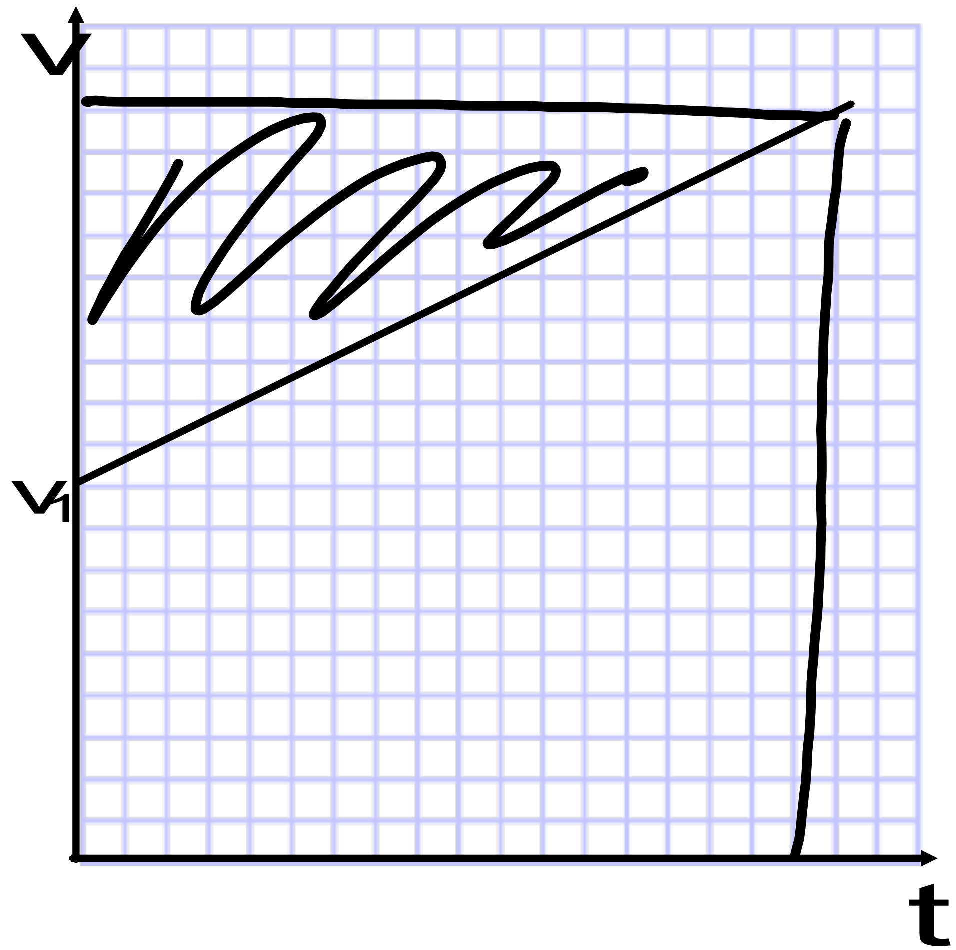
d =area under the graph

$d = v_1t + ½(v_2-v_1)t$ Eq^n 1

$d = v_1t + ½(at)t$

$d= v_1t + ½at^2$

3



d = area of large rectangle - area of triangle

$d = v_2t - ½(v_2 - v_1)t$

← Eq^n 1

$d = v_2t - ½(at)t$

$$d = v_2t - ½at^2$$

4. Go back to #2

$$d = v_1 t + \tfrac{1}{2}(v_2 - v_1)t$$

$$d = \frac{2v_1 t + (v_2 - v_1)t}{2}$$

$$d = \frac{2v_1 t + v_2 t - v_1 t}{2}$$

$$d = \frac{v_1 t + v_2 t}{2}$$

$$\boxed{d = \frac{(v_1 + v_2)t}{2}}$$

Note: $v_{average} = \frac{v_1 + v_2}{2}$

5. Go back to # 1

5. $a = \frac{v_2 - v_1}{t}$ Rearrage for v_2

$v_2 = v_1 + at$ Square both sides

$v_2^2 = (v_1 + at)^2$ ← Foil

$v_2^2 = v_1^2 + 2v_1at + a^2t^2$ Move v_1^2 to other side

$v_2^2 - v_1^2 = 2v_1at + a^2t^2$ factor out 2a from all terms on RHS

$v_2^2 - v_1^2 = 2a(v_1t + ½at^2)$ ← Equation # 2

=d

$$v_2^2 - v_1^2 = 2ad$$

Each of these five equations holds true for any object that has a constant acceleration. So memorize them!

Quiz Feb 25

Equation	d	a	v_2	v_1	t
1	✗	✓	✓	✓	✓
2	✓	✓	✗	✓	✓
3	✓	✓	✓	✗	✓
4	✓	✗	✓	✓	✓
5	✓	✓	✓	✓	✗

Example: Ethan is driving a really cool car at 100 km/h when he suddenly brakes at -20 m/s^2 coming to rest. What distance does this deceleration take?

$-(v_1^2)$

$v_1 = 100\,km/h \div 3.6 = 27.8\,m/s$

$v_2 = 0$

$a = -20\,m/s^2$

~~$t =$~~

$d = ?$

$2ad = v_2^2 - v_1^2$

$2(-20)d = 0^2 - 27.8^2$

$\frac{-40d}{-40} = \frac{-772.84}{-40}$

$d = 19.3\,m$

Pg 72 # 54, 55, 58, 60, 68*