

The equations of motion

- ▶ The **equations of motion** can be used when an object is accelerating at a steady rate
- ▶ There are four equations relating five quantities

u initial velocity, v final velocity,
 s displacement, a acceleration, t time
SUVAT equations

Beware!

- ▶ All quantities are vectors. These equations are normally done in one dimension, so a negative result means displacement/velocity/acceleration in the opposite direction.

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Choose the equation that has these quantities in

$$v = u + at$$



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$$v = u + at$$

$$0 = 10 + -2t$$

$$2t = 10$$

$$\underline{t = 5 \text{ seconds}}$$



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$$v^2 = u^2 + 2as$$



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$$v^2 = u^2 + 2as$$

$$0^2 = 10^2 + 2x-2s$$

$$0 = 100 - 4s$$

$$4s = 100$$

$s = 25\text{m}$, the car does not hit Jack. ☹️



Example 3

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$$u = 24 \text{ m.s}^{-1} \quad a = -9.8 \text{ m.s}^{-2} \quad v = 12 \text{ m.s}^{-1}$$

$$t = ?$$

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$$v = u + at$$

$$12 = 24 + -9.8t$$

$$-12 = -9.8t$$

$$\underline{t = 12/9.8 = 1.2 \text{ seconds}}$$

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$$v = u + at$$

$$-12 = 24 + -9.8t$$

$$-36 = -9.8t$$

$$\underline{t = 36/9.8 = 3.7 \text{ seconds}}$$

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$$t = 1.2, v = 12, a = -9.8, u = 24 \text{ s} = ?$$

$$s = ut + \frac{1}{2}at^2 = 24 \times 1.2 + \frac{1}{2} \times -9.8 \times 1.2^2$$

$$s = 28.8 - 7.056 = \underline{21.7 \text{ m}}$$

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- ▶ What is the displacement of the ball at those times? ($t = 1.2, 3.7$)

$$t = 3.7, v = 12, a = -9.8, u = 24 \text{ s} = ?$$

$$s = ut + \frac{1}{2}at^2 = 24 \times 3.7 + \frac{1}{2} \times -9.8 \times 3.7^2$$

$$s = 88.8 - 67.081 = \underline{21.7 \text{ m (the same?!)}}$$

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$$u = 24, t = 1.50, a = -9.8, v = ?$$

$$v = u + at$$

$$v = 24 + -9.8 \times 1.50 = \underline{9.3 \text{ m.s}^{-1}}$$

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- ▶ What is the maximum height reached by the ball?

$$u = 24, a = -9.8, \underline{v = 0}, s = ?$$

$$v^2 = u^2 + 2as$$

$$0 = 24^2 + 2 \times -9.8 \times s$$

$$0 = 24^2 - 19.6s$$

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- ▶ A ball is thrown upwards with a velocity of 24 m.s^{-1} .
- ▶ What is the maximum height reached by the ball?

$$u = 24, a = -9.8, \underline{v = 0}, s = ?$$

$$0 = 242 - 19.6s$$

$$19.6s = 242$$

$$s = 242 / 19.6 = \underline{12.3 \text{ m}}$$

Let's do a shed load of questions



Pg. 57 # 1 - 4,
6, 8, 10 - 12
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