Using the Constant Acceleration Formulae

Starter

In the following situations, decide which equation you would use to solve the problem. You do not need to find the required value.

(a) $a = 3, u = 2, v = 9$ find t (b) $s = 50, v = 11, a = 2$ find u

(c) $v = 9, s = 35, t = 5$ find a (d) $u = 1, a = 2.5, t = 6$ find s

(e) $t = 4, s = 86, v = 7$ find u (f) $u = 8, t = 6, s = 100$ find a

(g) $u = 3, a = 2, s = 38$ find v (h) $v = 10, u = 6, a = 1.5,$ find t

Working:

(a) No s $\Rightarrow$ $v = u + at$ (b) No t $\Rightarrow$ $v^2 = u^2 + 2as$

(c) No u $\Rightarrow$ $s = vt - \frac{1}{2}at^2$ (d) No v $\Rightarrow$ $s = ut + \frac{1}{2}at^2$

(e) No a $\Rightarrow$ $s = \frac{1}{2}(u + v)t$ (f) No v $\Rightarrow$ $s = ut + \frac{1}{2}at^2$

(g) No t $\Rightarrow$ $v^2 = u^2 + 2as$ (h) No s $\Rightarrow$ $v = u + at$

E.g. 1 A bowls player projects the jack along the green with a speed of 4 m/s. It comes to rest 'short' at a distance of 25 m.

(a) What is the retardation caused by the surface of the green?

(b) With what speed should the jack be projected to reach a length of 30 m?

Working:

(a) The jack comes to rest so $v = 0$.

$u = 4, s = 25, v = 0, a = ?$

No t $\Rightarrow$ $v^2 = u^2 + 2as$: $0^2 = 4^2 + 2 \times a \times 25$

$-50a = 16$

$a = -\frac{8}{25} = -0.32$

The retardation is 0.32 m/s^2

(b) $v = 0, s = 30, a = -0.32, u = ?$

No t $\Rightarrow$ $v^2 = u^2 + 2as$: $0^2 = u^2 + 2 \times (-0.32) \times 30$

$u^2 = 19.2$

$u = \frac{4\sqrt{30}}{5} \approx 4.38$

The jack must be projected with a speed of 4.38 m/s (3 s.f.)

E.g. 2 The driver of a train begins the approach to a station by applying the brakes to produce a steady deceleration of 0.2 m/s² and brings the train to rest at the platform in 1 minute and 30 seconds. Find:

(a) the speed of the train in m/s at the moment when the brakes were applied

(b) the distance then travelled before stopping.

Working: (a) $a = -0.2, v = 0, t = 90, u = ?$

No s $\Rightarrow$ $v = u + at$: $\quad 0 = u + (-0.2) \times 90$

$u = 18$

The speed of the train when the brakes were applied was 18 m/s

(b) $a = -0.2, v = 0, t = 90, s = ?$

No u $\Rightarrow$ $s = vt - \frac{1}{2}at^2$: $\quad s = 0 - \frac{1}{2} \times (-0.2) \times 90^2$

$s = 810$

The distance then travelled before stopping is 810 m

N.B. Notice that we avoid using the answer from (a) in case it is incorrect. In some questions this is not possible.

E.g. 3 At the same instant two children, who are standing 24 m apart begin to run directly towards each other. James starts from rest at a point A, running with a constant acceleration of 2 m/s² and William runs with a constant speed of 2 m/s. Find how long it is before they meet.

Working: The two children running towards one other is equivalent to one child running 24 m with an initial speed of 2 m/s and an acceleration of 2 m/s².

$u = 2, s = 24, a = 2, t = ?$

No v $\Rightarrow$ $s = ut + \frac{1}{2}at^2$: $\quad 24 = 2t + \frac{1}{2} \times 2 \times t^2$

$24 = t^2 + 2t$

$t^2 + 2t - 24 = 0$

$(t + 6)(t - 4) = 0$

$\therefore t = -6$ or $t = 4$

Since $t \geq 0$, it is 4 seconds before the children meet.

Video: Constant acceleration (horizontal)

Constant acceleration (horizontal) EQ

Solutions to Starter and E.g.s

Exercise

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