SUVAT Equations

1 $v = u + at$

2 $s = ut + \frac{1}{2}at^2$

3 $s = vt - \frac{1}{2}at^2$

4 $v^2 = u^2 + 2as$

5 $s = \frac{(u+v)}{2}t$

Vertical Motion

2. A firework rocket starts from rest at ground level and moves vertically. In the first 3 s of its motion, the rocket rises 27 m. The rocket is modelled as a particle moving with constant acceleration a m s^{-2}. Find

(a) the value of a,

(2)

(b) the speed of the rocket 3 s after it has left the ground.

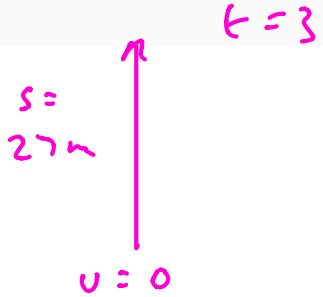
(2)

After 3 s, the rocket burns out. The motion of the rocket is now modelled as that of a particle moving freely under gravity.

(c) Find the height of the rocket above the ground 5 s after it has left the ground.

(4)

a)



$s = ut + \frac{1}{2}at^2$

$27 = 0 + \frac{1}{2}a \times 3^2$

$27 = \frac{9}{2}a$

$27 \times \frac{2}{9} = a$

$a = 6\ \text{m s}^{-2}$

b) Find v

$v = u + at$

$v = 0 + 6 \times 3$

$v = 18 \text{ ms}^{-1}$

Alternative

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

$v^2 = 0 + 2 \times 6 \times 27$

$v^2 = 324$

$v = \sqrt{324}$

$v = 18 \text{ ms}^{-1}$

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c)

Consider motion from B for next 2 seconds

$s = ut + \frac{1}{2}at^2$

$s = 18 \times 2 - 4.9 \times 2^2 = 16.4 \text{ m}$

Height above ground $= 27 + 16.4$

$= 43.4 \text{ m}$

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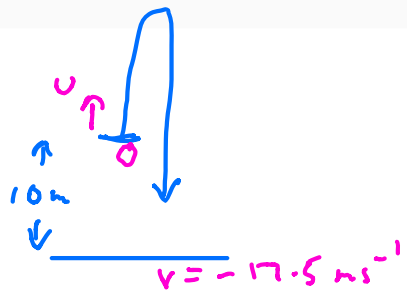
2. At time $t = 0$, a particle is projected vertically upwards with speed u m s^{-1} from a point 10 m above the ground. At time T seconds, the particle hits the ground with speed 17.5 m s^{-1} . Find

(a) the value of u,

(3)

(b) the value of T.

(4)



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

$(-17.5)^2 = u^2 - 19.6(-10)$

$306.25 - 196 = u^2$

$110.25 = u^2$

$u = 10.5 \text{ ms}^{-1}$