Edexcel M1 May 2013

A car is travelling along a straight horizontal road. The car takes 120 s to travel between two sets of traffic lights which are 2145 m apart. The car starts from rest at the first set of traffic lights and moves with constant acceleration for 30 s until its speed is 22 m s^{-1}. The car maintains this speed for T seconds. The car then moves with constant deceleration, coming to rest at the second set of traffic lights.

(a) Sketch, in the space below, a speed-time graph for the motion of the car between the two sets of traffic lights.

(2)

(b) Find the value of T.

(3)

A motorcycle leaves the first set of traffic lights 10 s after the car has left the first set of traffic lights. The motorcycle moves from rest with constant acceleration, a m s^{-2}, and passes the car at the point A which is 990 m from the first set of traffic lights. When the motorcycle passes the car, the car is moving with speed 22 m s^{-1}.

(c) Find the time it takes for the motorcycle to move from the first set of traffic lights to the point A.

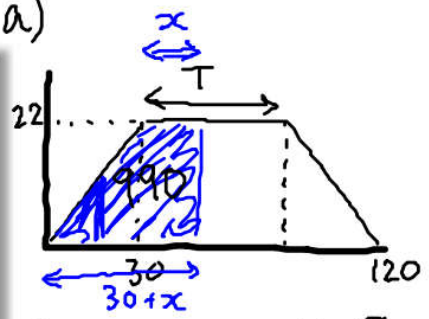
(4)

(d) Find the value of a.

You won't likely have the knowledge for (d) yet...

(2)

a)



b) Area = 2145

$2145 = \frac{1}{2}(T+120) \times 22$

$2145 = 11(T+120)$

$195 = T+120$

$T = 75$.

c) Mot 990m

Car 990m

time for car = ?

d) $990 = \frac{1}{2}(x+30+x) \times 22$

$990 = 11(2x+30)$

$90 = 2x+30$

$x = 30$

Car 60seconds

Motor. 50 seconds

Edexcel M1 May 2012 Q4

A car is moving on a straight horizontal road. At time $t = 0$, the car is moving with speed 20 m s^{-1} and is at the point A. The car maintains the speed of 20 m s^{-1} for 25 s. The car then moves with constant deceleration 0.4 m s^{-2}, reducing its speed from 20 m s^{-1} to 8 m s^{-1}. The car then moves with constant speed 8 m s^{-1} for 60 s. The car then moves with constant acceleration until it is moving with speed 20 m s^{-1} at the point B.

(a) Sketch a speed-time graph to represent the motion of the car from A to B.

(3)

(b) Find the time for which the car is decelerating.

(2)

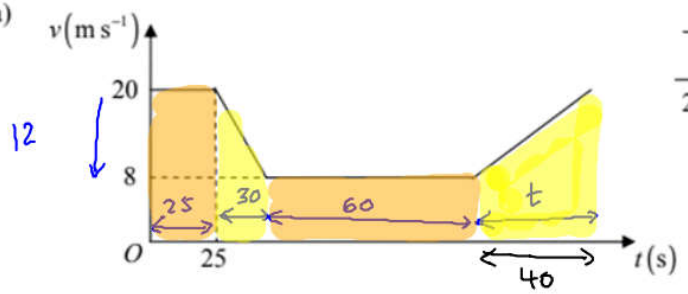
Given that the distance from A to B is 1960 m,

(c) find the time taken for the car to move from A to B.

(8)

know that:
ity

(a)



20, 8, 25

B1
B1
B1 **(3)**

(b) $v = u + at \Rightarrow 8 = 20 - 0.4t$

$t = 30$ (s)

$12 \div 0.4 = 30$

M1
A1 **(2)**

(c) Area

$1960 = (25 \times 20) + (30 \times 8) + (\tfrac{1}{2} \times 30 \times 12) + (60 \times 8) + 8 \times t + \tfrac{1}{2} \times t \times 12$

$1960 = 25 \times 20 + \frac{1}{2}(20+8) \times 30 + 60 \times 8 + \frac{1}{2}(8+20)t$

M1A3 **ft**
(2 ,1, 0)

$1960 = 500 + 240 + 180 + 480 + 14t$ $\quad t = 40$

DM1 A1

$T = 115 + 40$

$= 155$

DM1

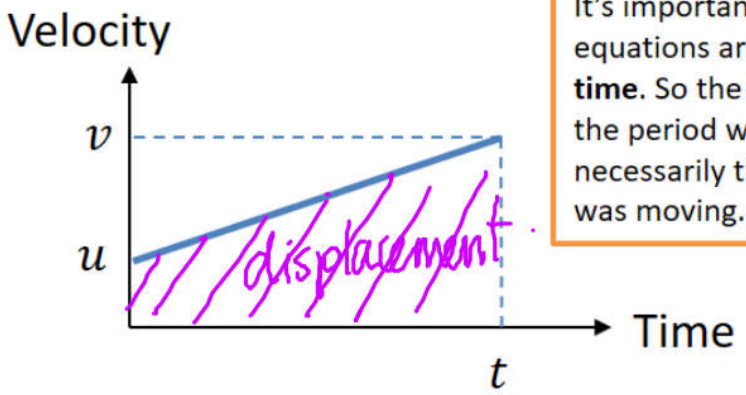
A1

(8)

SUVAT Equations (Part 1)

When there is **constant acceleration**, there are a variety of formulae which relate the following 5 quantities:

s: displacement
u: initial velocity
v: final velocity
a: acceleration
t: time



It's important you recognise these equations are for **a specific interval of time**. So the time t is the duration of the period we're considering, not necessarily the time since the object was moving.

Each SUVAT equation we will see involves 4 of the 5 quantities. Typically in a problem we'll know 3 of the quantities and we wish to find an unknown 4th quantity. We therefore select the appropriate equation.

Using the gradient of the graph (which we know is acceleration):

$a = \frac{v-u}{t} \quad \rightarrow \quad v = u + at$

You are expected to be able to **prove** each SUVAT question using the above graph.

Using the area under the graph (which we know gives distance):

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

Memorisation Tip: This formula is effectively "distance = average speed × time" which you knew from GCSE.

A cyclist is travelling along a straight road. She accelerates at a constant rate from a velocity of 4 ms^{-1} to a velocity of 7.5 ms^{-1} in 40 seconds. Find:

(a) the distance she travels in these 40 seconds

(b) her acceleration in these 40 seconds.

$t = 40$

$u = 4$

$v = 7.5$

$s = ?$

$a = ?$

a) $s = \left(\frac{u+v}{2}\right)t$

$= \left(\frac{4+7.5}{2}\right)40$

$= 230\ m$

b) $v = u + at$

$7.5 = 4 + 40a$

$7.5 - 4 = 40a$

$a = \frac{3.5}{40} = 0.0875\ ms^{-2}$

$= \underline{0.088\ ms^{-2}\ (2sf).}$

A particle moves in a straight line from a point A to a point B with a constant deceleration 1.5 ms^{-2}. The velocity of the particle at A is 8 ms^{-1} and the velocity of the particle at B is 2 ms^{-1}. Find:

(a) the time taken for the particle to move from A to B.

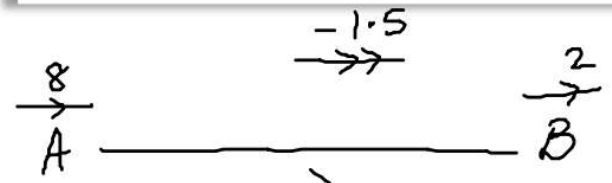
(b) the distance from A to B.

After reaching B the particle continues to move along the straight line with constant deceleration 1.5 ms^{-2}. The particle is at the point C 6 seconds after passing through the point A. Find:

(c) the velocity of the particle at C.

(d) The distance from A to C.

As stated before, think about what period of time we're considering.



a)

$a = -1.5$

$u = 8$

$v = 2$

$t = ?$

$v = u + at$

$2 = 8 - 1.5t$

$1.5t = 8 - 2$

$t = \frac{6}{1.5} = 4$ secs.

b) $s = ?$

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

$s = \left(\frac{8+2}{2}\right)4$

$s = 20$m.

c)

A to C

$a = -1.5$

$t = 6$

$u = 8$

$v = ?$

$\therefore v = u + at$

$= 8 - 1.5 \times 6$

$v = -1$ ms^{-1}

→ so at C, the particle has started travelling back towards A.

d) $s = ?$

$u = 8$

$v = -1$

$t = 6$

$s = \left(\frac{8-1}{2}\right)6$

$s = 21$m.

Your Turn

A car moves from traffic lights along a straight road with constant acceleration. The car starts from rest at the traffic lights and 30 second later the car passes a speed-trap where it is registered as travelling at 45 km h^{-1}. Find:

(a) the acceleration of the car

(b) the distance between the traffic lights and the speed-trap.

$45\ kmh^{-1} = 45000\ mh^{-1} = \frac{45000}{60}\ m\ min^{-1} = \frac{45000}{60\times60}\ ms^{-1}$

$= 12.5\ ms^{-1}$

$u = 0$

$v = 12.5$

$t = 30$

$a = ?$

$v = u + at$

$12.5 = 0 + 30a$

$a = \frac{12.5}{30} = \frac{5}{12}\ ms^{-2} = \underline{0.42\ ms^{-2}}$ (2sf).

$s = \left(\frac{u+v}{2}\right)t = \left(\frac{0+12.5}{2}\right)30 = 187.5\ m$

$= \underline{190\ m}$ (2sf)

Ex 9C

Evens