LAW-ADUE EMMANUEL
19/ENG05/069 (200 Lvl)
MECHATRONICS
ENG224

QUESTION ONE (1)

1) For $S = 0.5t^3$;

$0 \leq t < 6$

$V = \frac{\partial S}{\partial t} = 1.5t^2$

$V_{(ms^{-1})}$	0	1.5	6	13.5	24	37.5	54
$t_{(s)}$	0	1	2	3	4	5	6

Table of values for v-t graph

At $t = 0$, $V = 0$

At $t = 6$, $V = 1.5(6^2) = 54 ms^{-1}$

For $S = 108$;

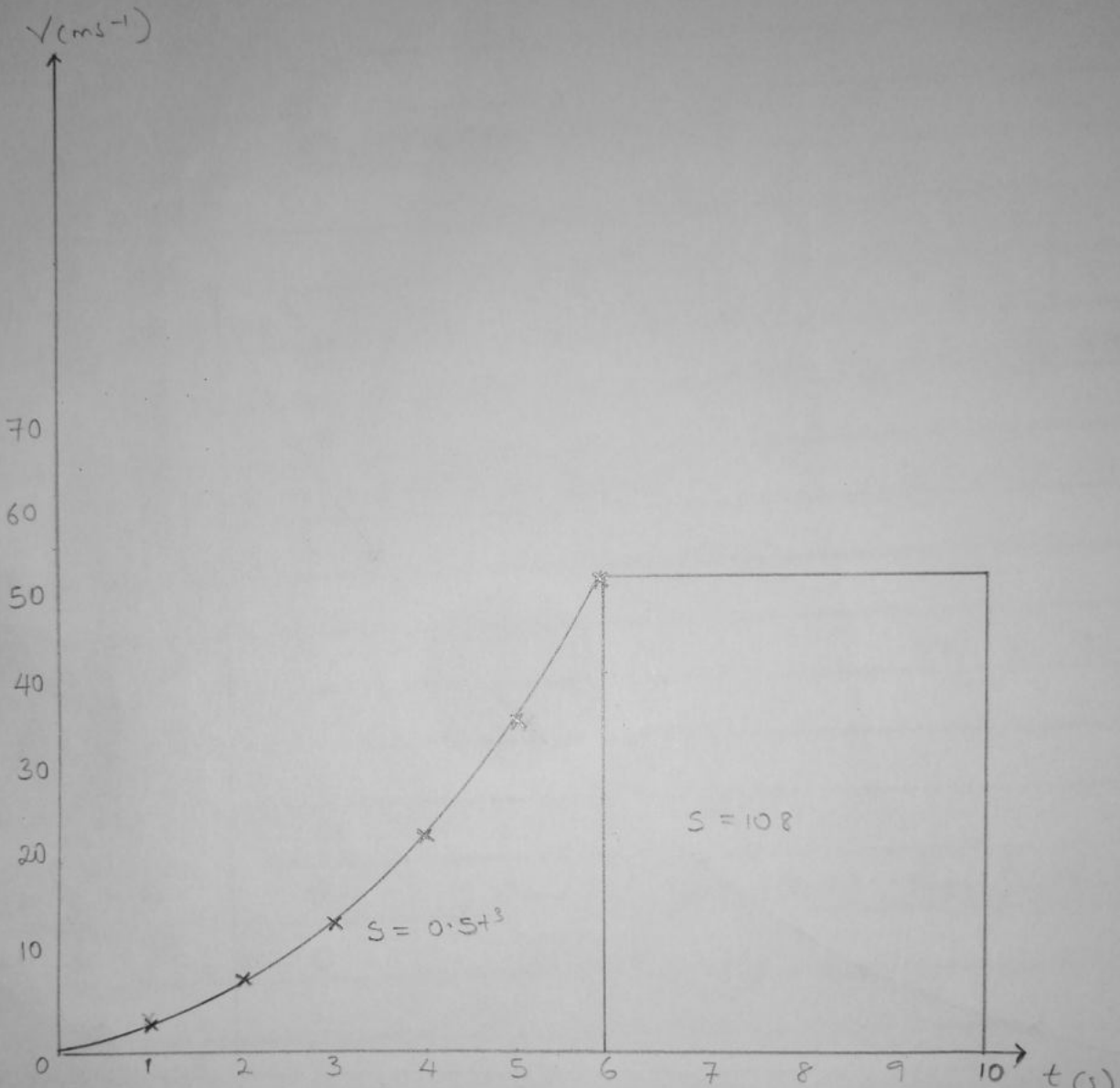
$6 < t \leq 10$

$V = \frac{\partial S}{\partial t} = 0$

At $t = 6$, $V = 0$

At $t = 10$, $V = 0$

; Velocity is constant throughout the motion when $S = 108$



V - t graph

QUESTION TWO (2) - - (F12-10)

1) $v = -4t + 80$

$v = \frac{\partial s}{\partial t}$

$\partial s = v \partial t$

$\int \partial s = \int v \partial t$: $\int \partial s = \int (-4t + 80)\, \partial t$

$s(t) = \frac{-4t^2}{2} + 80t + C$

$s(t) = -2t^2 + 80t + C$

When $t = 0$, $s = 0$

$\Rightarrow s(0) = 0$

To find the value of C : $0 = \frac{-4(0)^2}{2} + 80(0) + C$

$C = 0$

$\rightarrow s(t) = -2t^2 + 80t$

t (s)	0	2	4	6	8	10	12	14	16	18	20
s (m)	0	152	288	408	512	600	672	728	768	792	800

Table of values for the s-t graph

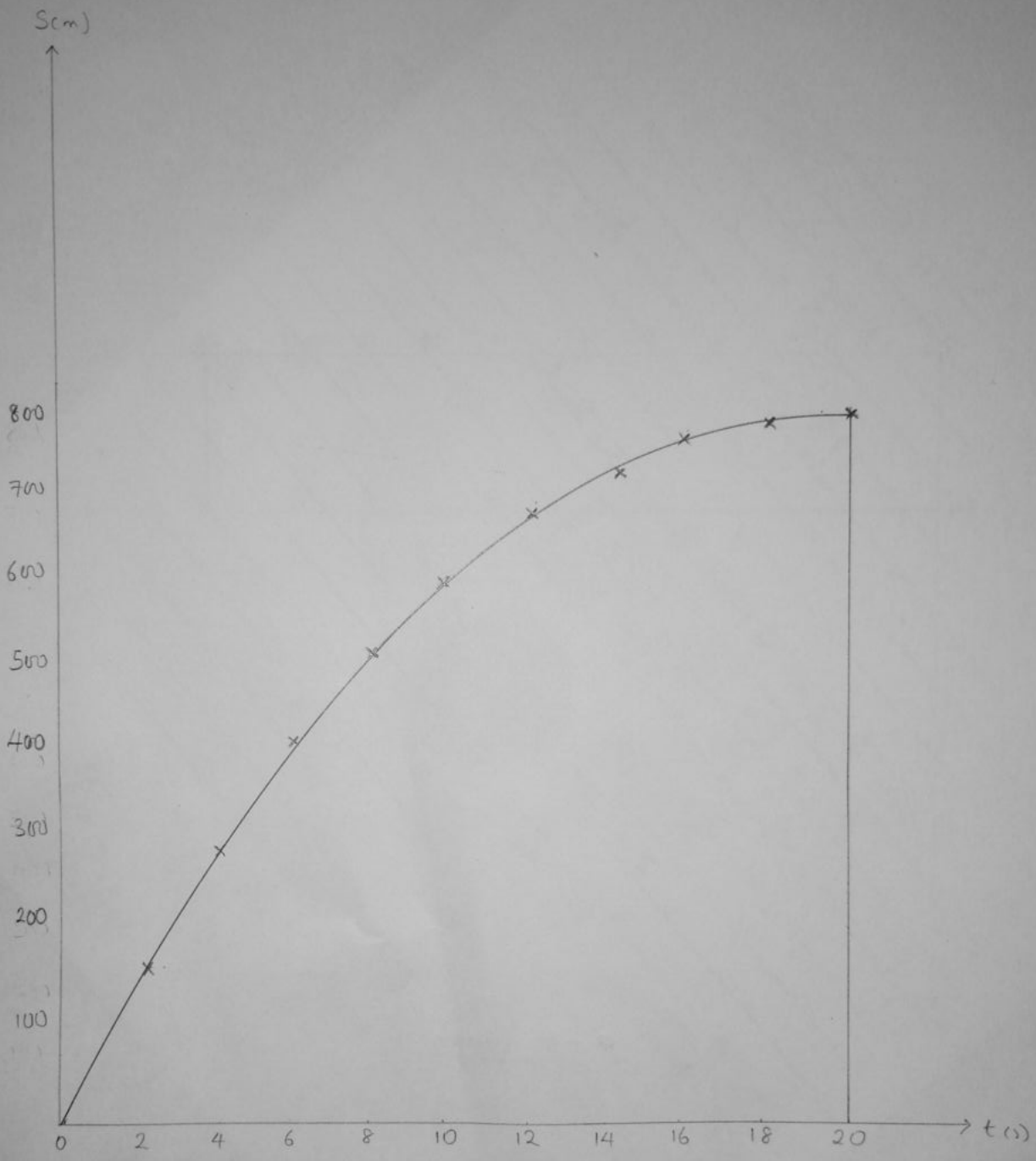
$a = \frac{\partial v}{\partial t}$

$a = \frac{\partial (-4t + 80)}{\partial t}$; $a = -4\ ms^{-2}$

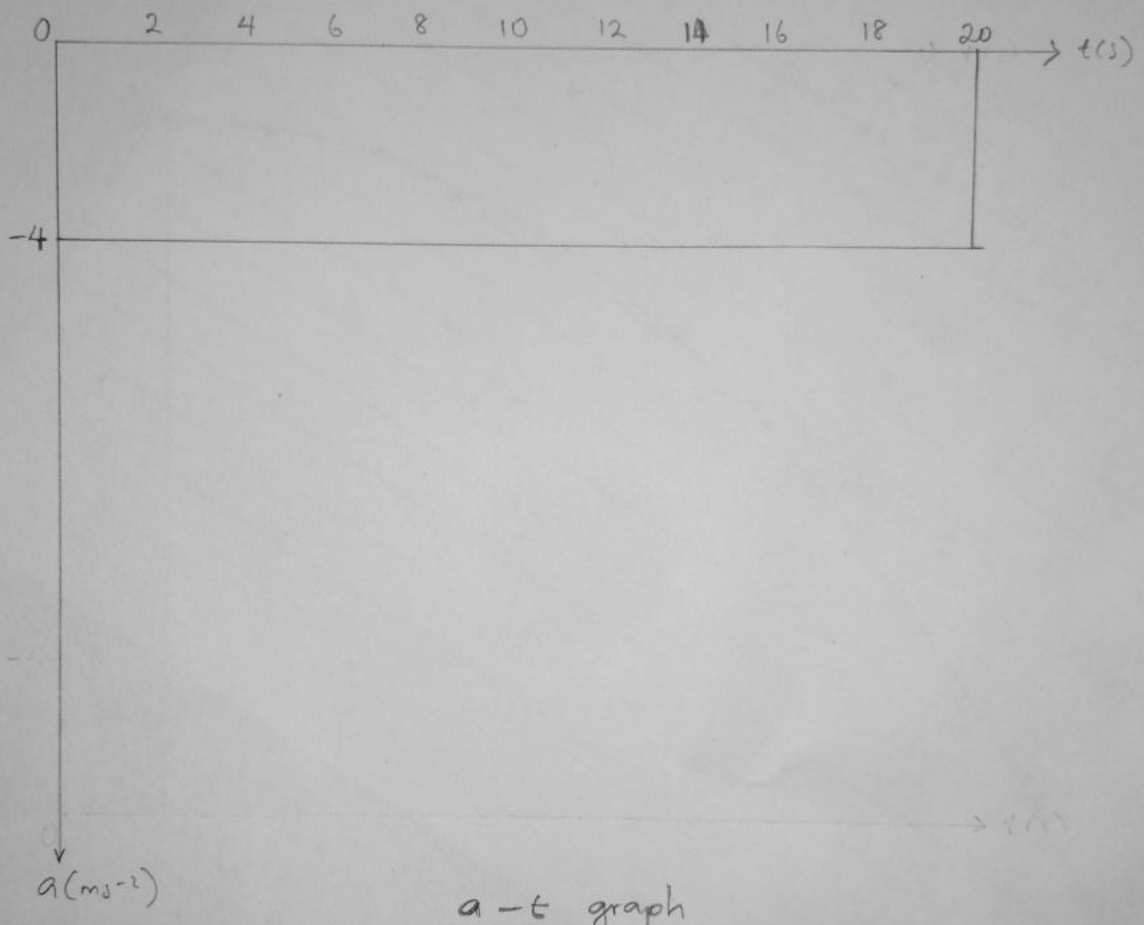
This implies that the acceleration is constant

t (s)	0	2	4	6	8	10	12	14	16	18	20
a (ms^{-2})	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4

Table of values for a-t graph



S – t graph



a – t graph

QUESTION 3 (F12-11)

3) $v = 0.25s$

$\frac{dv}{ds} = 0.25$

Recall, $a\,ds = v\,dv$

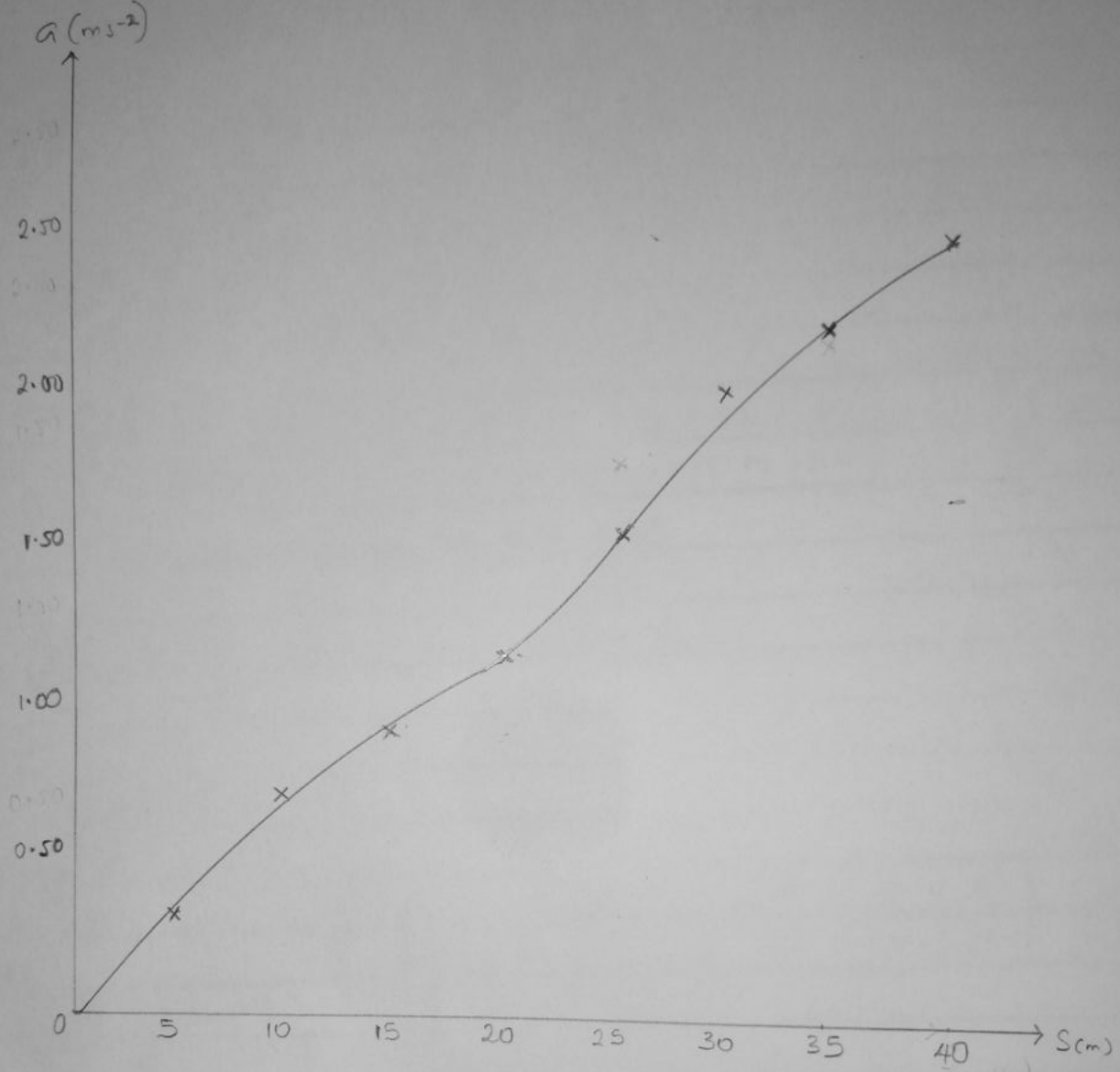
$a = v\frac{dv}{ds}$

$a = 0.25s \times 0.25$

$a = 0.0625s$

s (m)	0	5	10	15	20	25	30	35	40
a (ms^{-1})	0	0.31	0.63	0.94	1.25	1.56	1.88	2.19	2.50

Table of values for the a-s graph



a-s graph

QUESTION 4

For Stage A :

$0 \leq t \leq 5$

$s = 3t^2$

$v = \frac{\partial s}{\partial t} = 6t \ (ms^{-1})$

$t(s)$	0	1	2	3	4	5
$V(ms^{-1})$	0	6	12	18	24	30

$a = 6 ms^{-2} = \frac{\partial v}{\partial t}$; The acceleration is constant through out the motion.

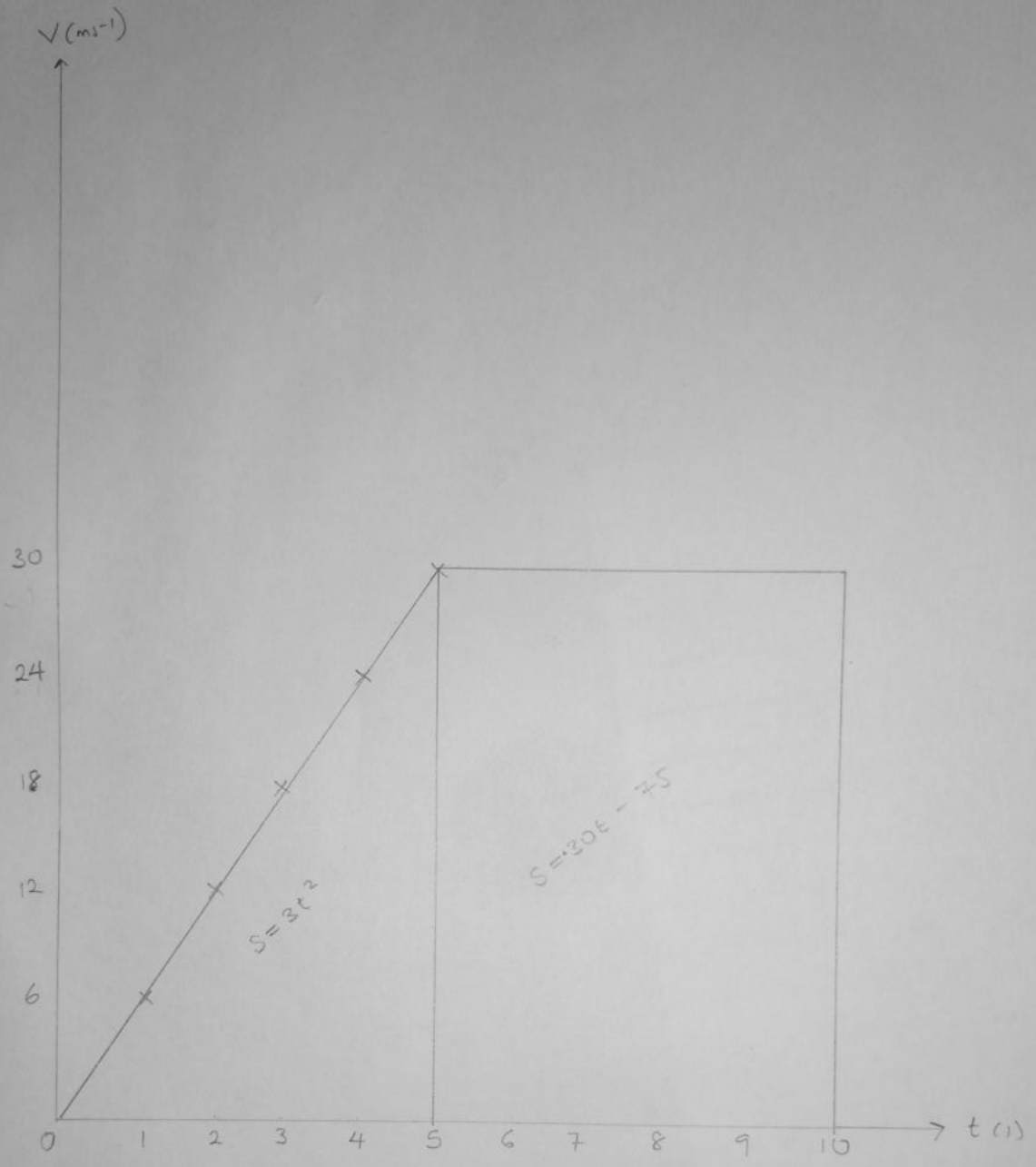
For Stage B :

$5 \leq t \leq 10$

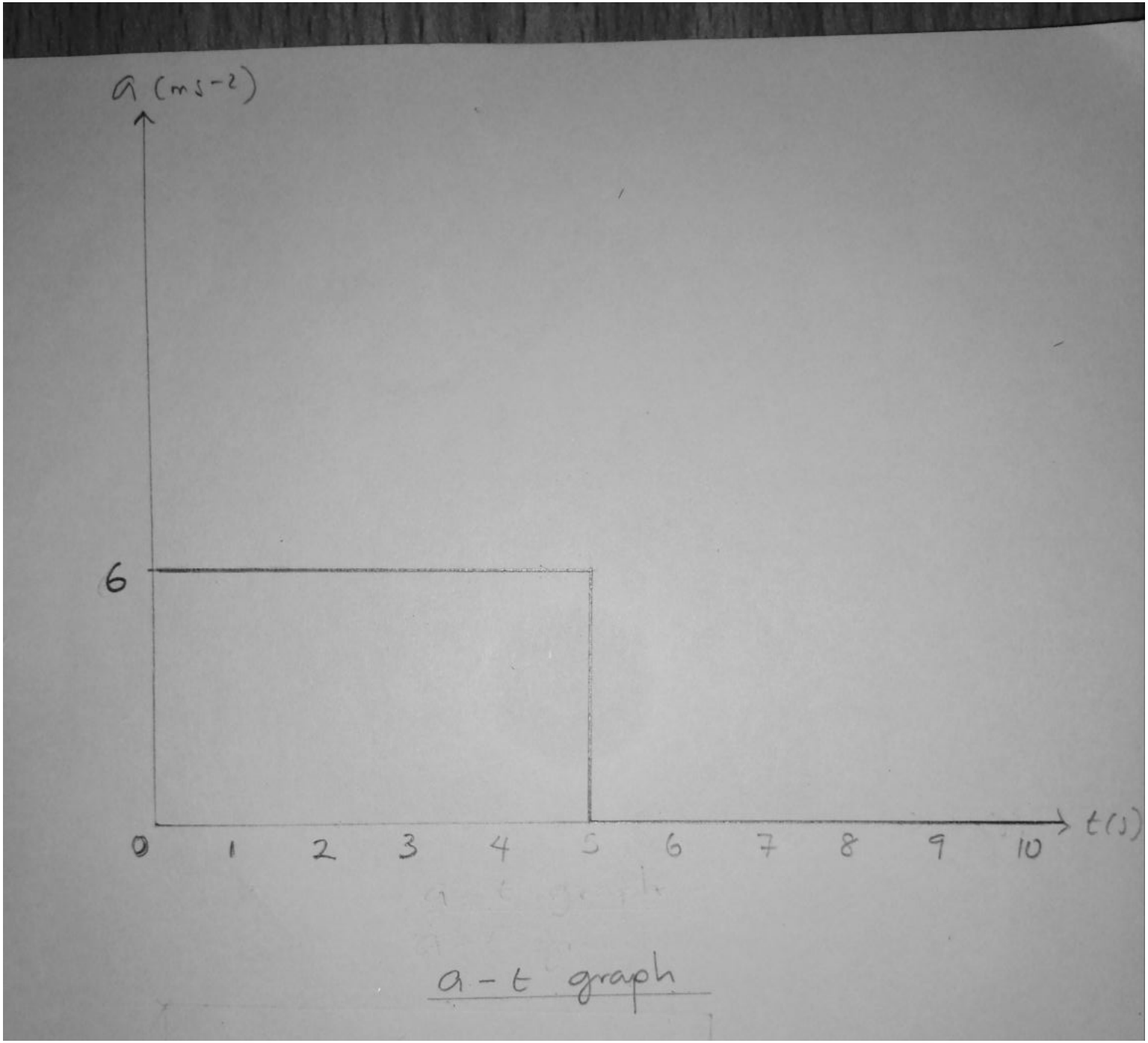
$s = 30t - 75$; The velocity is constant throughout the motion

$v = \frac{\partial s}{\partial t} = 30 ms^{-1}$

$a = \frac{\partial v}{\partial t} = 0 ms^{-2}$; The acceleration is constant throughout the motion



V - t graph



a - t graph

QUESTION 5 (F12-13)

For $0 \leq t \leq 5$, $a = 20\ ms^{-2}$

$$\int \partial v = \int a \partial t$$

$$v = \int_0^5 20 \partial t \quad : \quad v = [20t]_0^5$$

$$v = 20(5)$$

$$v = 100\ ms^{-1}$$

For the second stage:

$5 \leq t \leq t'$, $a = -10\ ms^{-2}$

$$\int \partial v = \int a \partial t$$

$$\int_{100}^{v} v = \int_{10}^{t'} -10 \partial t$$

$$v - 100 = (-10t') - (-100)$$

$$v - 100 = -10t' + 100$$

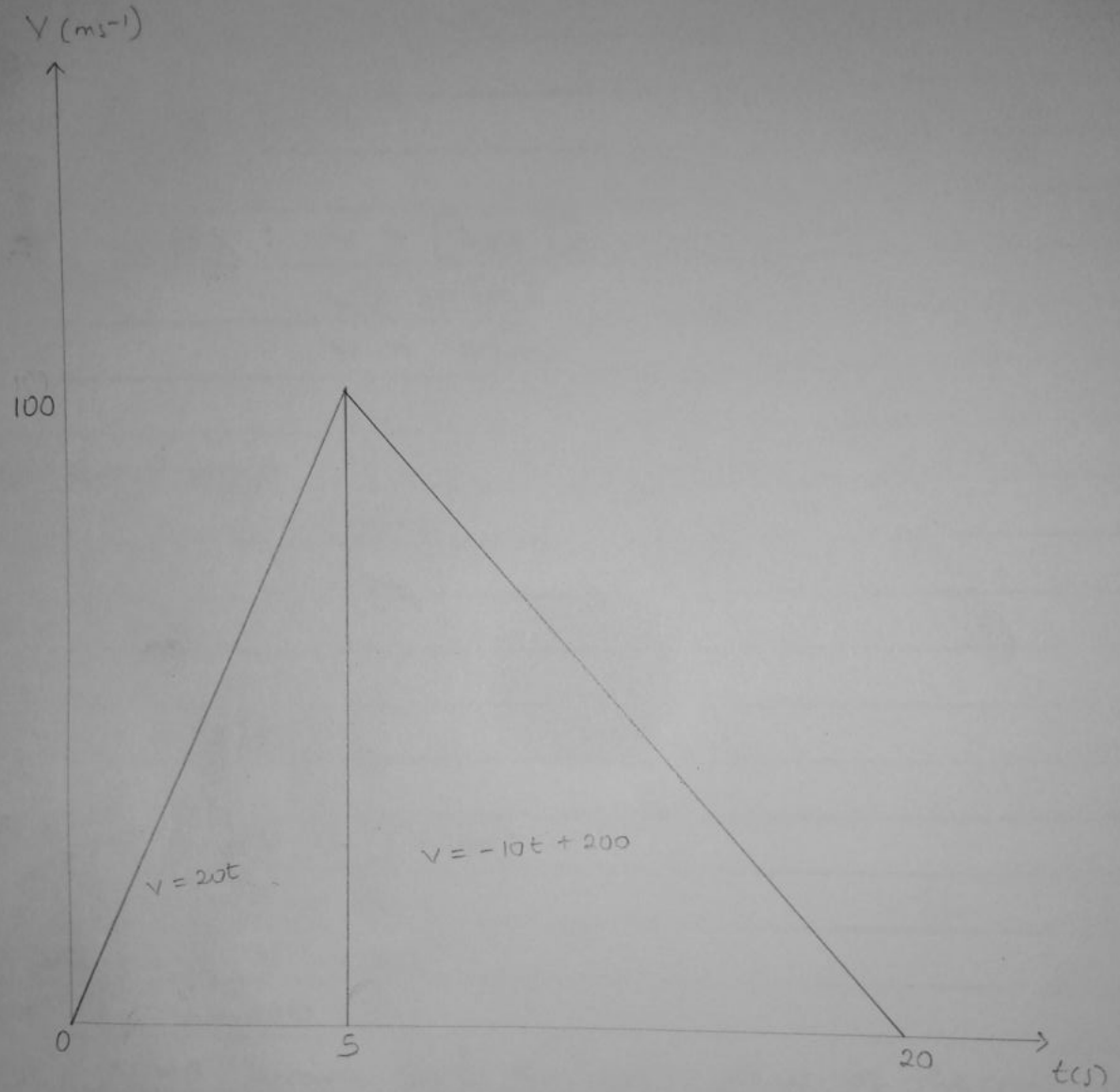
$$v - 100 - 100 = -10t'$$

$$-10t' = v - 200$$

Recall, $v = 0$ because that's the resting point of the car

$$-10t' = -200$$

$$t' = 20 \text{ secs}$$ ///



V-t graph

QUESTION 6 (F12 - 14)

STAGE A :

$0 \leq t \leq 5$

$v = 30t$

$v = \frac{ds}{dt}$: $ds = v\,dt$

$$s = \int_0^5 v\,dt = \int_0^5 30t\,.\,dt$$

$$s = \left[\frac{30t^2}{2}\right]_0^5$$

- $s = 15(5^2) = 375\,m$ -- final displacement
- $s = 15(0) = 0\,m$ -- initial displacement

s(m)	0	15	60	135	240	375
t(s)	0	1	2	3	4	5

$[s = 15t^2]$

Table of values for the s-t graph

STAGE B :

$5 \leq t \leq 15$

$v = -15t + 225$

$v = \frac{ds}{dt}$: $ds = v\,dt$

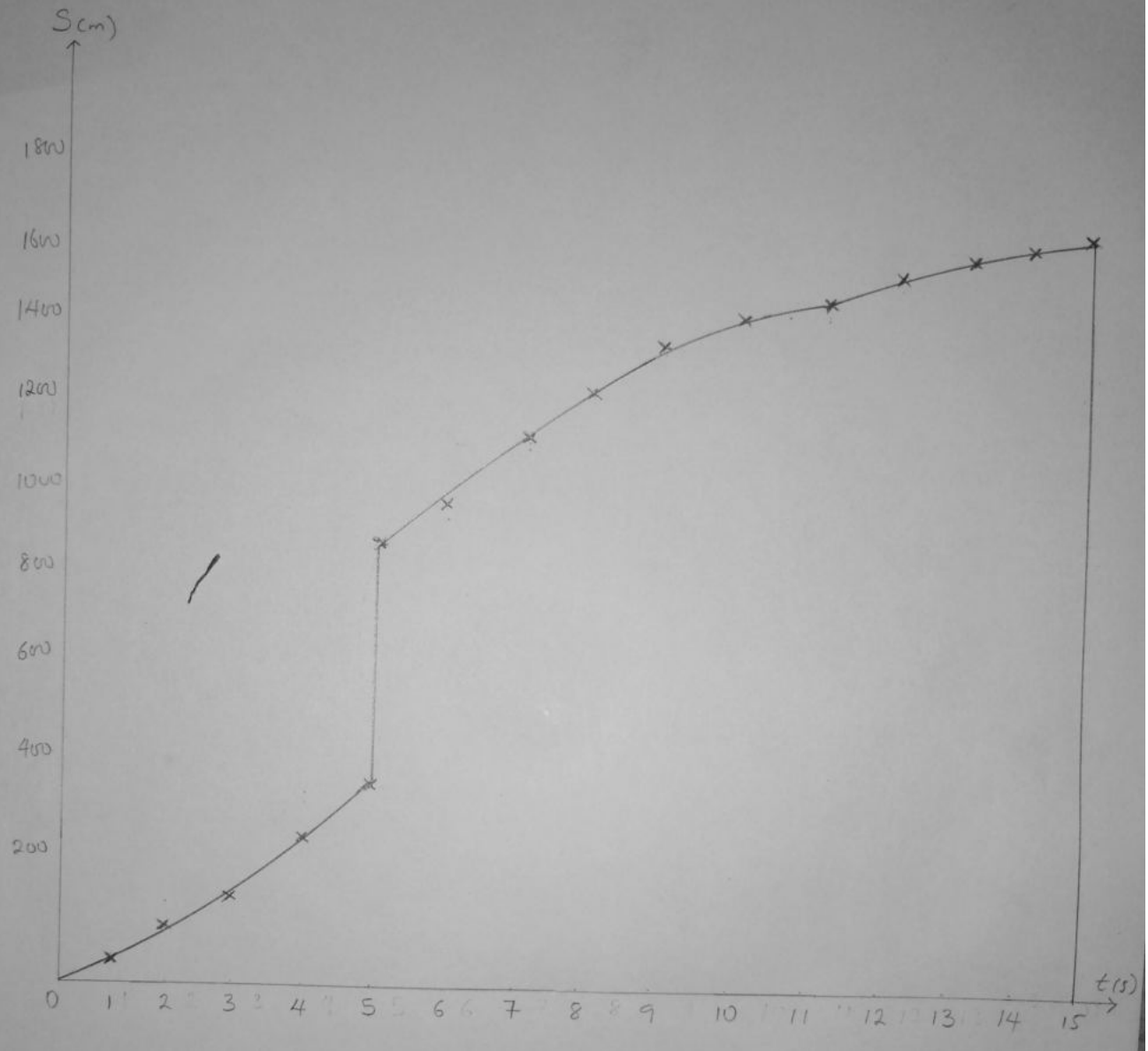
$$s = \int_5^{15} v\,dt = \int_5^{15} (-15t + 225)\,dt$$

$$s = \left[\frac{-15t^2}{2} + 225t\right]_5^{15}$$

- $s = \frac{-15(15^2)}{2} + 225(15) = 1687.5\,m$ -- final
- $s = \frac{-15(5^2)}{2} + 225(5) = 937.5\,m$ -- initial

s(m)	937.5	1080	1207.5	1320	1417.5	1500	1567.5	1620	1657.5	1680	1687.5
t(s)	5	6	7	8	9	10	11	12	13	14	15

Total distance travelled = $375 + 1687.5 = 2062.5\,m$ ///


S(cm)
1800
1600
1400
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
t(s)

S-t graph