Vectors and Kinematics Name: Maggie.

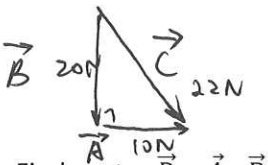
19/19

1. Consider the following 2 vectors

$\vec{A}$ = 10 N →

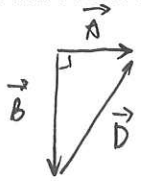
$\vec{B}$ = 20 N ↓

(a) Find vector $\vec{C} = \vec{A} + \vec{B}$ (2 marks)



$\vec{C} = \vec{A} + \vec{B} = 10\sqrt{5} \approx 22N$. ✓ 2

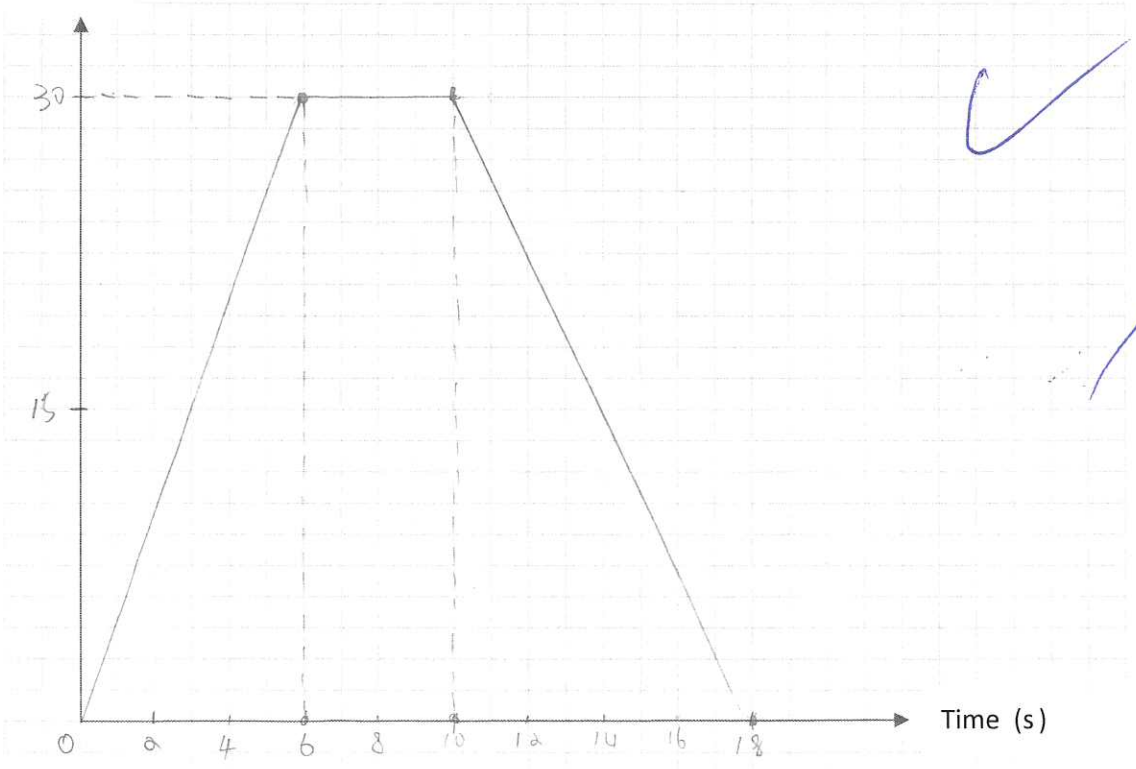
(b) Find vector $\vec{D} = \vec{A} - \vec{B}$ (2marks)



$\vec{D} = \vec{A} - \vec{B} = 22N$. ✓ 2

2. A car accelerates uniformly in a straight line for 6 seconds and reaches a max speed of 30 ms^{-1}. It maintains this speed for an additional 4 seconds and then slows down at a constant rate for another 8 seconds until finally stopping. Sketch a Velocity / Time graph in the space below. (3 marks)

Velocity (ms^{-1})



✓ 3

(b) On the axis below sketch a position / time graph describing the cars' journey.
(find the total displacement beforehand so that you can scale your graph to fit)

$S_1 = \frac{u_1 + v_1}{2} \cdot t_1$

$= \frac{0 + 30}{2} \cdot 6$

$= 90\,m.$

$S_2 = v_1 t_2$

$= 30 \cdot 4$

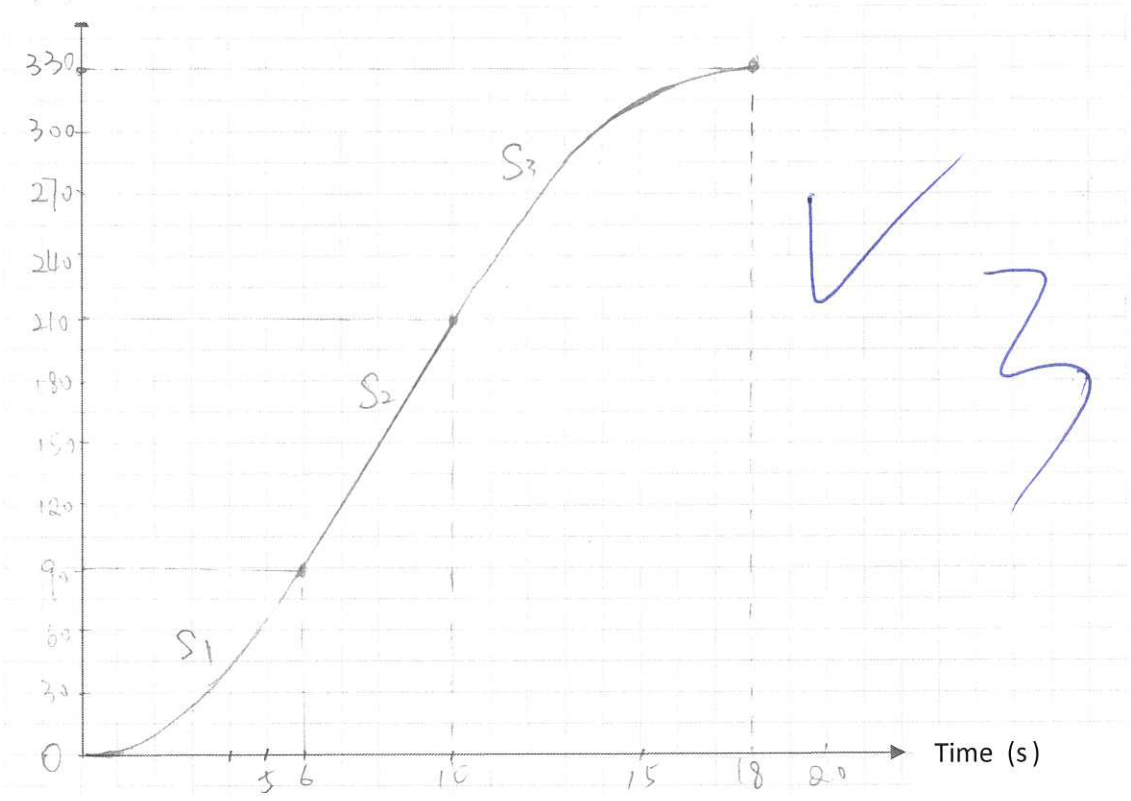
$= 120\,m.$

$S_3 = \frac{u_2 + v_2}{2} \cdot t$

$= \frac{30 + 0}{2} \cdot 8$

$= 120\,m.$

Position (m)



$S_1 = ut + \frac{1}{2}at^2$

$= \frac{1}{2}t^2$

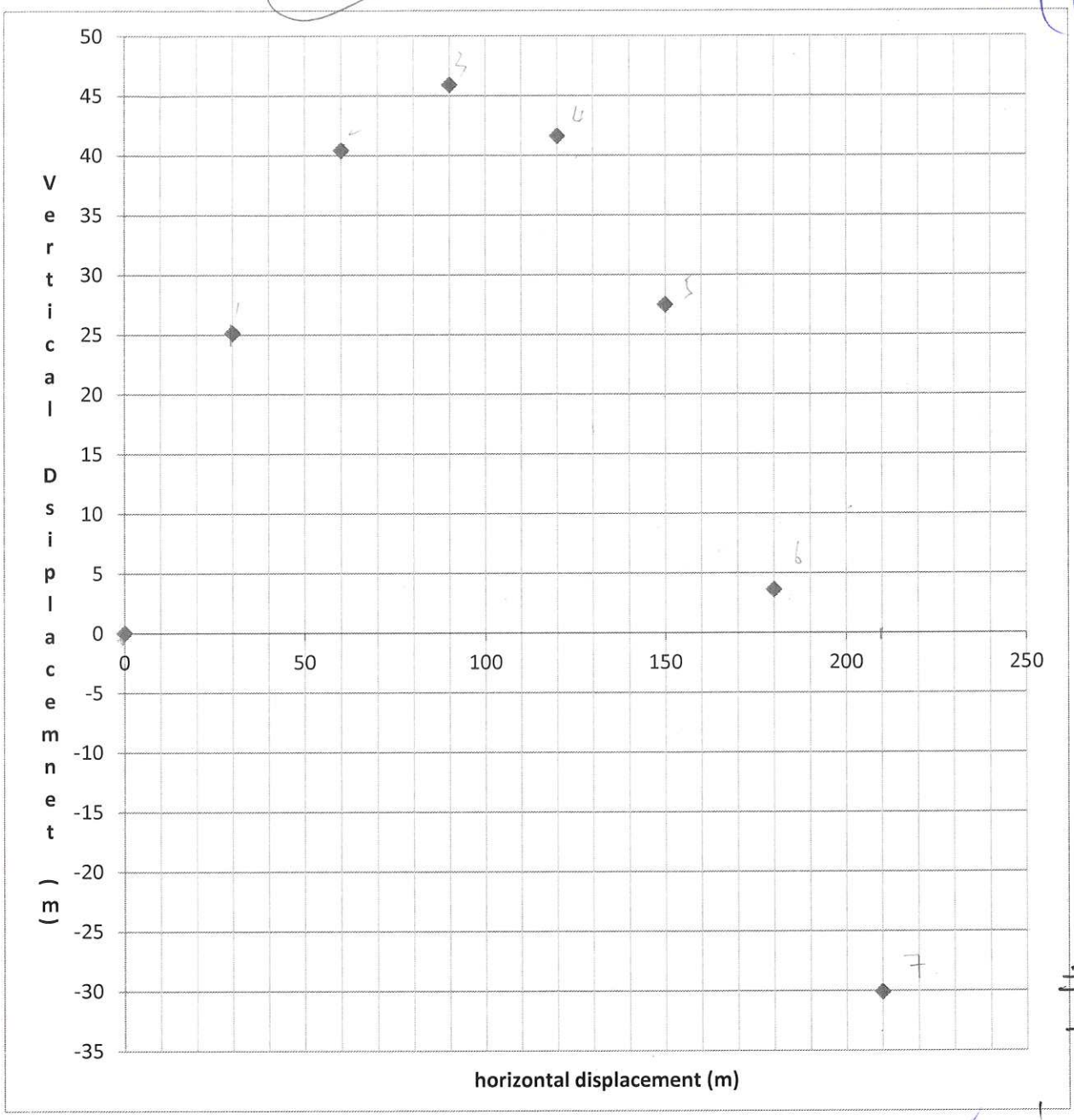
$S_2 = 30t - 90$

$S_3 = 30t - \frac{1}{2}\frac{30}{8}t^2$

$= 30t - \frac{15}{8}t^2$

3. An object is launched from (0,0) and **for each second after launch** the position of the projectile is shown. Time = 0 Seconds represents the first dot at (0,0)

(a) What is the total horizontal displacement after 7 seconds? 1 mark 210 m. ✓ (1)



⇒ Continued.

(b) What is the total vertical displacement after 7 second of flight? 2 marks ✓2

-30 m.

(c) What is the horizontal velocity after 7 seconds? 1 mark ✓1

$\vec{v}_x = \frac{S}{t} = \frac{210\text{m}}{7\text{s}} = 30\text{ m/s}.$

(d) Estimate the velocity (both horizontal and vertical) 7 seconds into the flight 2 marks

$\vec{v}_x = 30$ m/s ✓

$\Delta\vec{v}_y = \vec{a}t = -9.81 \times 7 = -68.67$ m/s. ✓2

since $S = \left(\frac{u+v}{2}\right)t = \left(\frac{2v_i - \Delta v}{2}\right)t = -30$ m.

(e) What will be the position of the object 9 seconds into the flight? 3 marks

Thus, $\vec{v}_x = 30$ m/s, $\vec{v}_y = -39$ m/s, $\vec{v} = 49$ m/s (52° to the x-axis)

$\frac{2v + 68.67}{2} \cdot 7 = -30$.

$v_y = -39$ m/s.

$\therefore v = \sqrt{30^2 + 39^2} = 49$ m/s.

s, t, a.

v = ?

$\Delta v = at$.

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

$= v$

$u + v$

$2v - \Delta v$.

(e) $\vec{v_x} = 30 \text{ m/s}$.

$S_x' = \vec{v_x} t' = 30 \times 9 = 270 \text{ m}$.

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

$= (39 + 68.67) \cdot 9 + \frac{1}{2}(-9.81) \cdot 9^2$

$= 267.03 - 397.305$

$= -130 \text{ m}$.

since S_y for $t = 7$.

$S_y = u(7) + \frac{1}{2}(-9.81) \cdot (7)^2 = -30$

$\therefore u = 30 \text{ m/s}$.

then for $t = 9$.

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

$= 30(9) + \frac{1}{2}(-9.81)(9)^2$

$= 270 - 397.305$

$= -127$

$\approx -130 \text{ m}$.

therefore, the position after 9s is $(270, -130)$.