United Arab Emirates
Ministry of Education

الإمارات العربية المتحدة
وزارة التربية والتعليم

Grade 10 Physics

Elite Stream

Academic Year 2022 – Term 3

EoT exam coverage

UNITED ARAB EMIRATES
MINISTRY OF EDUCATION

المدرسة الإماراتية

$$x = at^2 + bt^1 + 2t^0 \qquad t^0 = 1$$

$$x$$

$$v = \frac{x}{t} \qquad \frac{dx}{dt} = 2 \times a t^{2-1} + b t^{1-1}$$

$$= 2at + b + 0$$

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

x = distance = $at^2 + bt + 2$

$$a = \frac{dv}{dt} \qquad \frac{dx}{dt} = \text{velocity} = 2at^{1-1} + b$$

$v = 2at + b$

$$a_c = \frac{dv}{dt} = 2a$$

$$x = at^2 + bt + c$$
$$= 1.1 \times 2^2 + 0.7 \times 2 + 1.3$$

$a = 1.1$
$b = 0.7$
$c = 1.3$
$t = 2\,\text{sec}$
$x = ?$
$v = ?$
$a = ?$

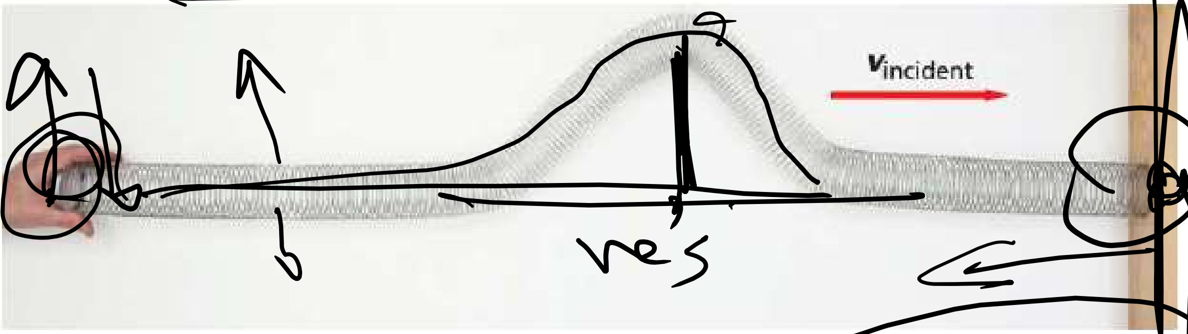
$$x = 7.1\ \text{m}$$

$$v = 2at + b$$
$$v = 2 \times 1.1 \times 2 + 0.7 = 5.1\ \text{m/s}$$

$$a = 2a$$
$$= 2 \times 1.1 = 2.2\ \text{m/s}^2$$

Example Question 1

A wave pulse is travelling along a horizontal slinky spring that is fixed at one end. Describe the reflected pulse in terms of speed, amplitude and whether it is upright or inverted.



inverted

Speed = same as incident wave

Amplitude = same as incident wave if there is not absorption of energy

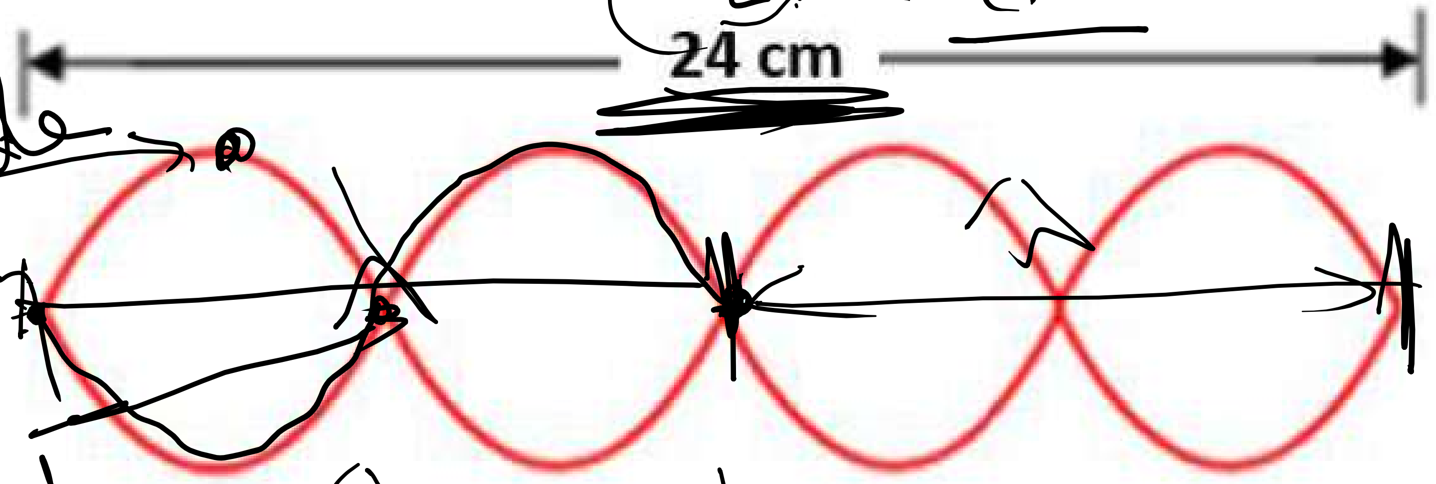
Inverted : because the boundary is fixed

Example Question 2

Standing waves

The fourth harmonic with a frequency of 500 Hz is created on a string of length 24 cm which is fixed at it ends as shown in the diagram below. Calculate the speed of the wave on the string.

$L = 2\lambda$



$L = 2\lambda$

$\lambda = \frac{1}{2} L$

$\lambda = \frac{L}{2} = 12\text{ cm}$

$\lambda = 2L / n$

here $n = 4$ and $L = 0.24\text{m}$

$\lambda = 2L / n = 2 \times 0.24 / 4 = 0.12\text{m}$

$f = 500\text{ Hz}$

$v = f\lambda = 500 \times 0.12 = 60\text{ m/s}$

$v = \lambda f$

$= 0.12 \times 500$

$\lambda = 0.12\text{m}$

$f = 500\text{ Hz}$

$n = 2 \rightarrow$ ①

$$\boxed{\lambda = \frac{1}{2} L}$$

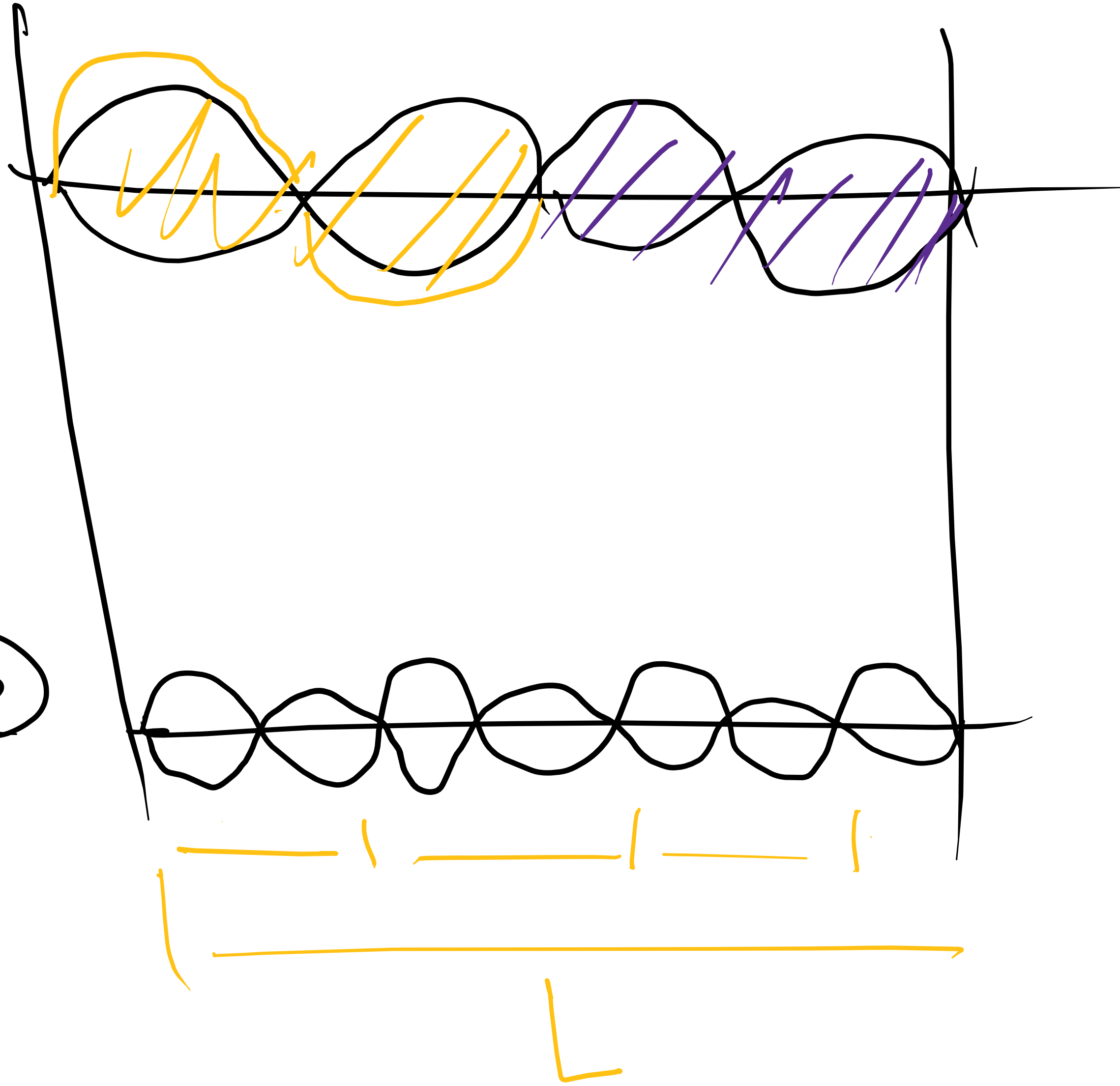
$n_2 = 3.5$

$L_2 = 3.5 \lambda \rightarrow$

$$\boxed{\lambda = \frac{1}{3.5} L}$$

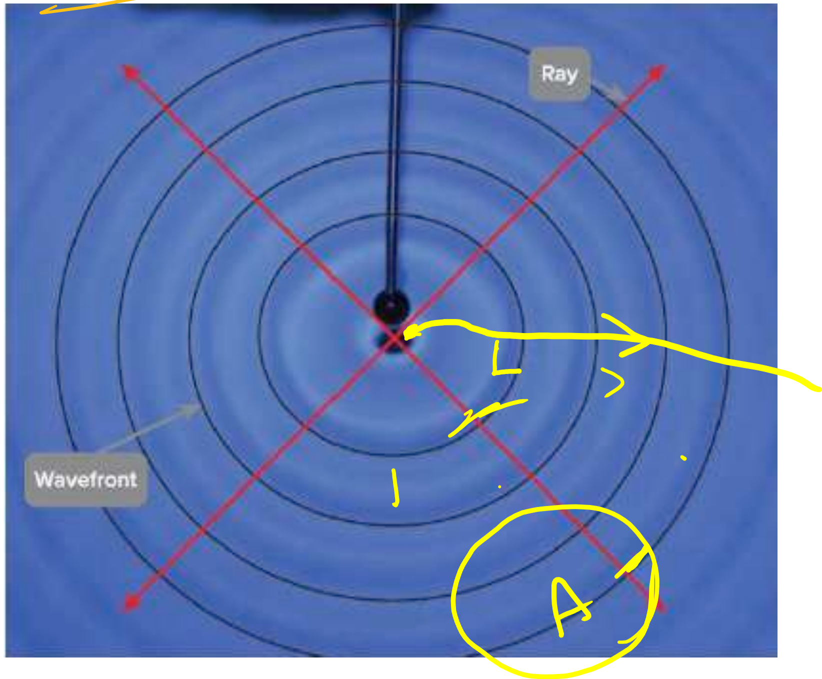
①

②



Example Question 3

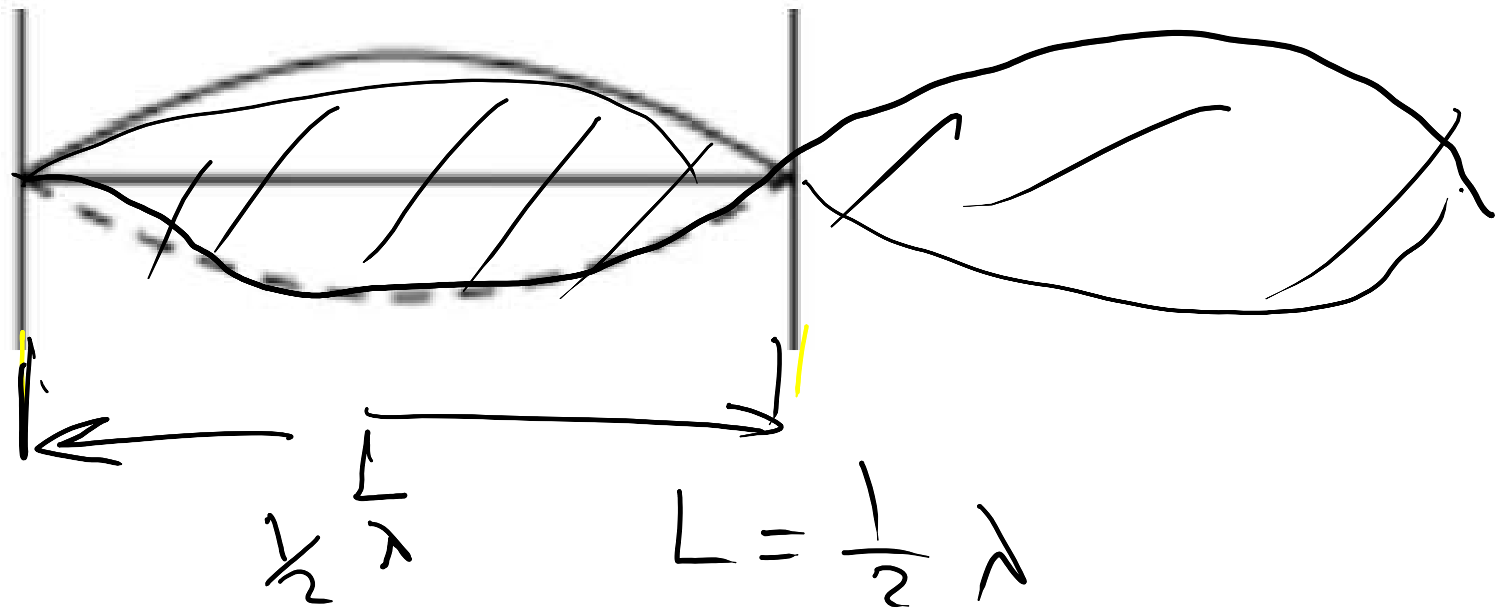
Describe the characteristics of wavefronts and rays, and the relationship between them.



- Wavefront is a line that represents crest of a wave in 2D
- A ray is line drawn at right angle to the wavefront
- Relationship: ray is perpendicular to wavefront at every point

Example Question 4

The first harmonic formed on a string of length 2 m that is fixed at its two ends, is shown below. Calculate the wavelength of this harmonic.



$L = \frac{1}{2}\lambda$

$\lambda = \frac{2L}{1} = 2 \times 2 = 4m$

$\lambda = 2L/n$

here n = 1 and L = 2m

$\lambda = 2L/n = 2x2 / 1 = 4m$

Basic Differentiation Formulas

$$\frac{dk}{dx} = 0 \qquad \text{where } k = \text{constant}$$

$$\frac{d(x)}{dx} = 1$$

$$\frac{d(kx)}{dx} = k \qquad \text{where } k = \text{constant}$$

$$\frac{d(x^n)}{dx} = nx^{n-1}$$

$$\frac{dx^3}{dx} = 3x^{3-1} = 3x^2$$

$$\frac{dk}{dx} = \frac{d5}{dx} = 0$$

$$\frac{d(x^1)}{dx} = 1 \cdot x^{1-1} = 1 x x^0 = 1$$

$$\frac{dx}{dx} = 1$$

$$\frac{d\,kx^1}{x} = k$$

$$\frac{d\,4t^3}{dt} = 12t^2$$

$$\frac{d\,5t^2}{dt} = 10t$$

$$\frac{d\,x^4}{dx} = 4x^3$$

$$\frac{d\,x^5}{dx} = 5x^4$$

$$\frac{d\,3x^3}{dx} = 3 \times \underline{3x^2} = 9x^2$$

$$\frac{d(7)}{dx} = 0$$

$$\frac{d9}{dx} = 0$$

$$\frac{d(7x)}{dx} = 7$$

$$\frac{d\,15x}{dx} = 15$$

$$\frac{d\,5x}{dx} = 5$$

$$\frac{d\,21x}{dx} = 21$$

$$\frac{d\,21}{dx} = 0$$

Example Question 5

The position of an object as a function of time is given as $\boxed{x = At^3 + Bt^2 + Ct + D}$. The constants are A = 2.10 m/s^3, B = 1.00 m/s^2, C = -4.10 m/s, and D = 3.00 m. Calculate the velocity of the object at t = 10.0 s.

$$v = \frac{dx}{dt} = \frac{d}{dt}\left(At^3 + Bt^2 + Ct + D\right)$$

$$\frac{dkx}{dx} = k$$

$$= 3At^2 + 2Bt + C + 0$$

$$+(-4.1)$$

$$v(10) = (3)(2.10)(10)^2 + 2(1)(10) - 4.10$$

$$= 630 + 20 - 4.10$$

645.9 m/s

$$v = 650 - 4.10 = 645.9 \text{ m/s}$$

Example Question 6

A position vector has a length of 40.0 m and is at an angle of 57.0° above the x-axis. What are the x and y components of the position vector?

$\bar{r}_y = 40 \sin 57$

$\bar{V}_x = \bar{V} \cos\theta = 40 \cos 57$

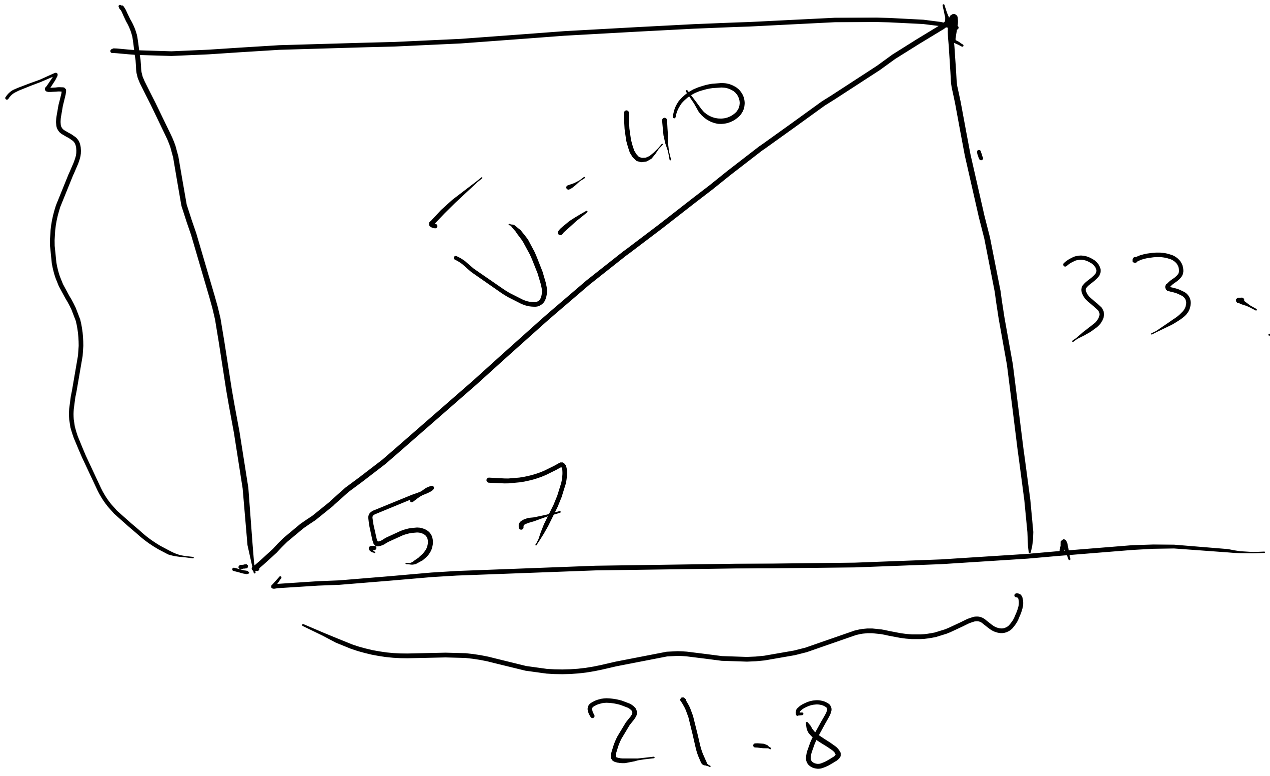
$= 21.8$ m

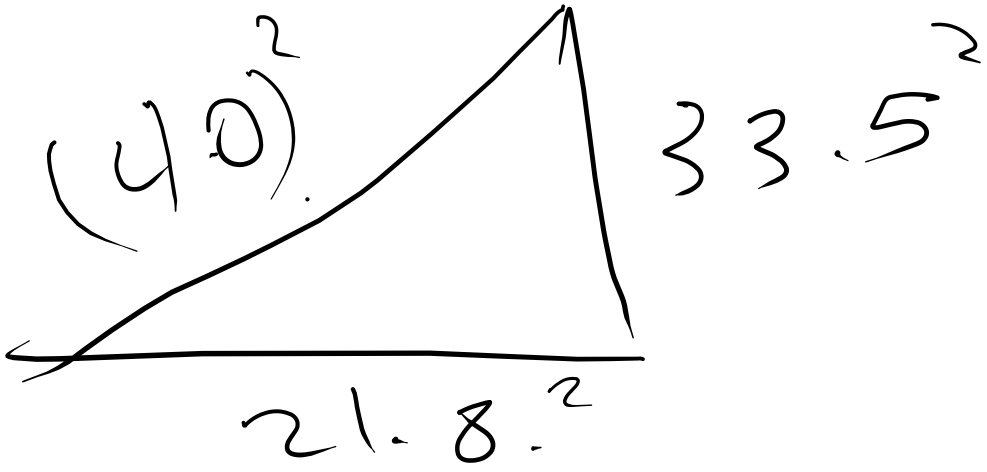
$\bar{r}_x = 40 \cos 57 =$

$\bar{V}_y = \bar{V} \sin\theta$

$= 40 \sin 57$

$= 33.5$ m


V = 40
57
33.5
21.8


(40)²
33.5²
21.8²

Example Question 7

The velocity as a function of time for an object moving along a straight line is given by the equation $v(t) = At^2 + Bt - C$. What is acceleration *a(t)* of the object as a function of time?

$$\bar{a} = \frac{dv}{dt} = \frac{d}{dt}\left(At^2 + Bt - C\right)$$

$$= \underline{2At} + B \quad 0$$

Example Question 8

The velocity as a function of time for object moving in a straight line is given by the equation $v(t) = 6t^2 + 9$. Calculate the displacement of the object between t = 0 and t = 10 seconds.

$$v = \frac{dx}{dt} \Longrightarrow dx = v\,dt$$

$$\int x^n dx = \frac{x^{n+1}}{n+1}$$

$$v = \boxed{6t^2 + 9}$$

$$a = \frac{dv}{dt} = \boxed{12t}$$

$a = 12t$

$v = a \times t$

$dv = \int a\,dt$

$$x = \int_{t_1}^{t_2} v\,dt = \int_0^{10} (6t^2+9)\,dt = \left(\frac{6t^3}{3} + 9t\right)_0^{10}$$

$a = 12t$ $\qquad$ $v = 6t^2 + 9$

$\cancel{a = \frac{dv}{dt}}$

$\cancel{\int dv} \quad v = \int a\,dt$

$v = \int a \cdot dt$

$v = \int a\,dt$

$= \int (12t)\,d \cdot t$

$= \frac{12\,t^{1+1}}{2} + \text{Constant}$

$= \frac{12\,t^2}{2} + C = 6t^2$

$$v = 6t^2 + 9$$

$$\cancel{v = \frac{dx}{dt}}$$

$$x = \int v \, dt$$

$$dx = v \cdot dt$$

$$x = \int v \, dt$$

$$= \int_0^{10} (6t^2 + 9t^0) \, dt$$

$$= \left(\frac{6t^{2+1}}{3} + \frac{9t^1}{1} \right)_0^{10}$$

$$x = (2t^3 + 9t)_0^{10}$$

$$x = 2 \times 10^3 + 9 \times 10$$

$$= 2000 + 90$$

$$\boxed{x = 2090 \text{ m}}$$

$$x = \left[\frac{6t^3}{3} + 9t\right]_0^{10}$$

$$x = \left[\frac{\overset{2}{\cancel{6}}(10)^3}{\cancel{3}} + 9(10)\right] - \left[\frac{6(0)^3}{3} - 9(0)\right.$$

$$= 2000 + 90 = 2090\,\text{m}$$

Example Question 9

Which of the following are vector quantities?

I. distance S
II. displacement V
III. speed S
IV. velocity v
V. acceleration v

+ −

+a −a

Example Question 10

The acceleration as a function of time for an object moving along a straight line is given by the equation a$(t) = 24t - 12$. If the initial velocity of the object is zero, what is the velocity v(t) of the object as a function of time?

$a = 24t - 12$

$\Rightarrow dv = a\,dt$

$v = \frac{24t^2}{2} - \frac{12t}{1}$

$\boxed{\int dv} = \int a\,dt$

$\boxed{v = 12t^2 - 12t}$

$\boxed{v_f - v_i} = \int (24t - 12)\,dt$

$v_f - \cancel{v_i}^{\,0}$

$v_f = \frac{24t^2}{2} - 12t$

$v = 12t(t-1)$ or

$v_0 = 12t^2 - 12t$

Example Question 11

600 s

A car travels north at 30.0 m/s for 10.0 min. It then travels south at 40.0 m/s for 20.0 min. Calculate the net displacement of the car

1200 s

30 m/s

N

30 m/s 600 s ⟹ $\bar{d} = 18000$ m North

0

40 m/s ⟹ $\bar{d}_2 = -48000$ m, S

1200 s

S

$\bar{d} = 30000$ m South

Example Question 11

A car travels north at 30.0 m/s for 10.0 min. It then travels south at 40.0 m/s for 20.0 min. Calculate the net displacement of the car

sec

$d_1 = v \cdot t$

$= 30 \times 10 \times 60$

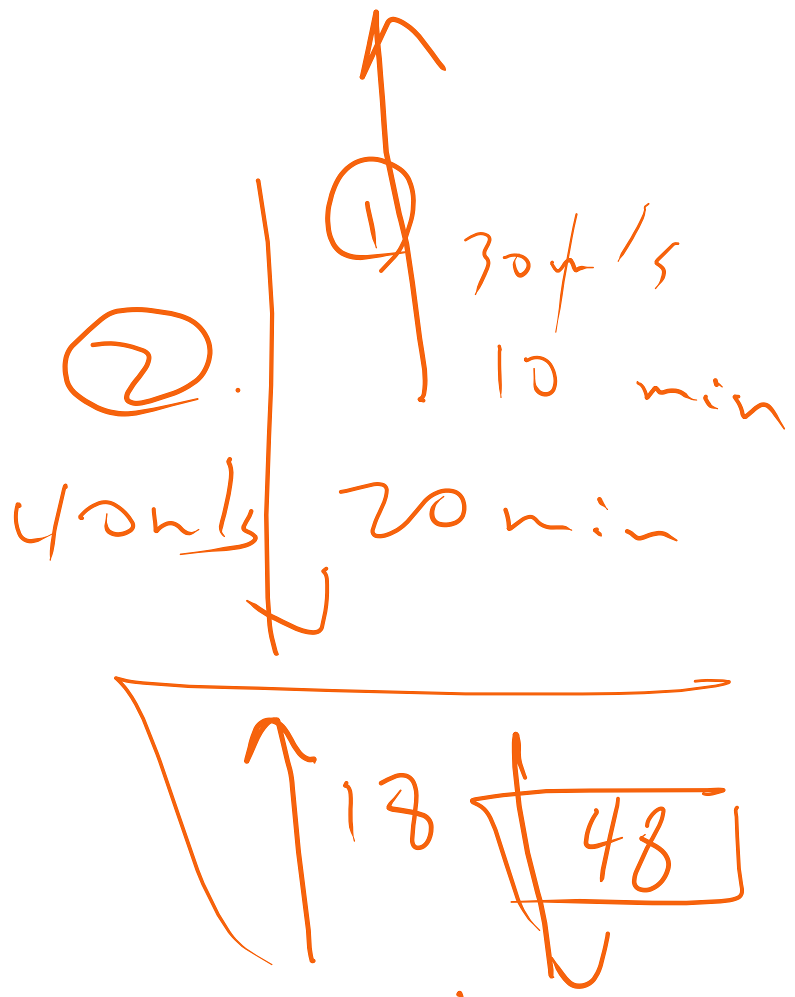
$= 18000$ m N↑

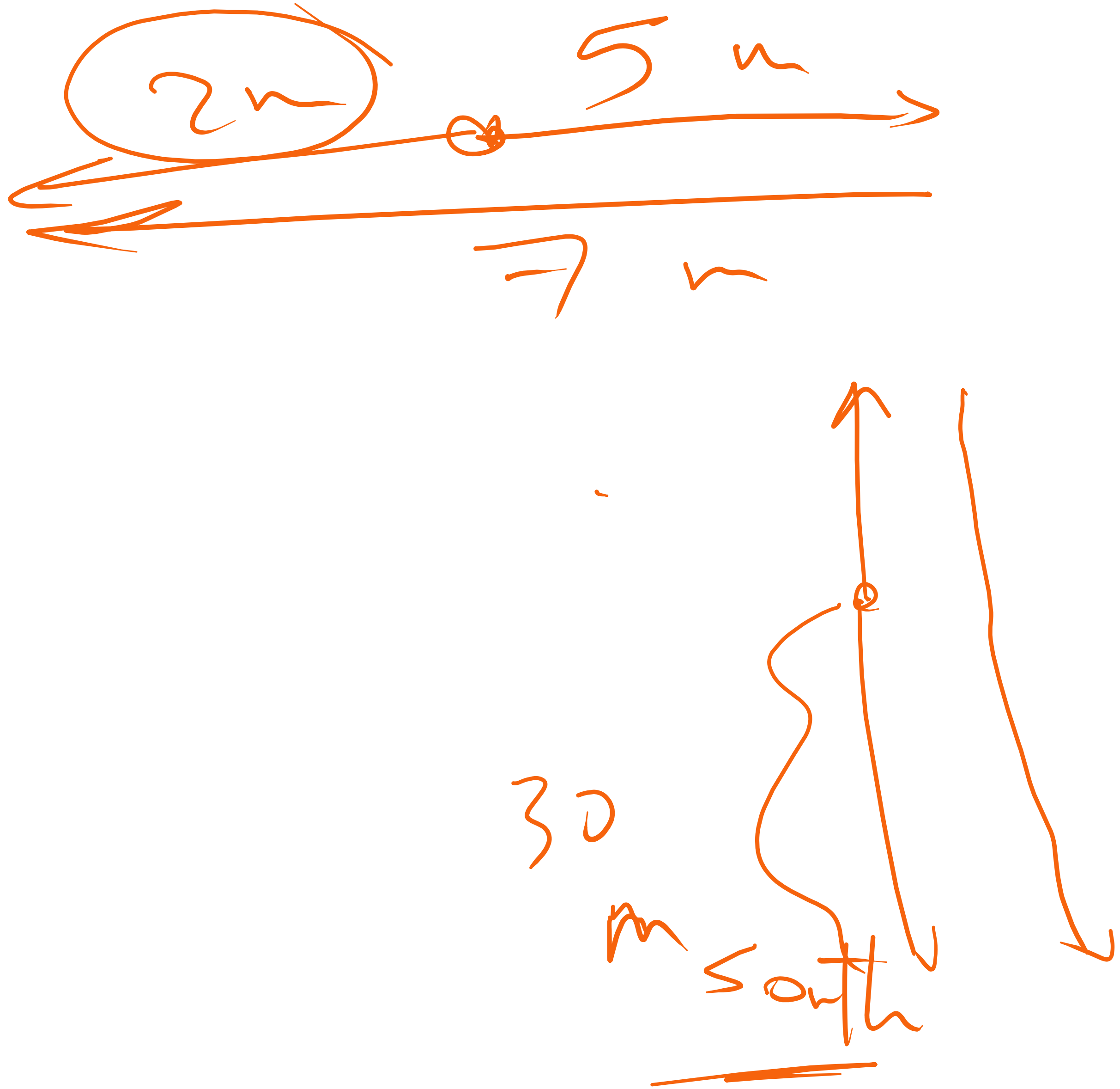
$d_2 = v_2 t_2$

$= 40 \times 20 \times 60$

$= 48000$ m S↓

$d = 48000 - 18000 = 30000$ m S↓




2m
5m
7m
30 m
south

Example Question 12

The position of a particle moving along the x-axis is given by $x = 11 + 14t - 2.0t^2$, where t is in seconds and x is in meters. Calculate the average velocity during the time interval from t = 1.0 s to t = 4.0 s.

$$x_i = 11 + 14(1) - 2(1)^2$$
$$= 11 + 14 - 2 = 23\text{ m}$$

$$x_f = 11 + 14(4) - 2(4)^2$$
$$= 11 + 56 - 32$$
$$= 11 + 24$$
$$= 35\text{ m}$$

$$\Delta x = vt$$
$$\bar{v} = \frac{\Delta x}{t}$$
$$= \frac{35 - 23}{3}$$
$$= \frac{12}{3}$$
$$= 4\text{ m/s}$$

Example Question 12

The position of a particle moving along the x-axis is given by $x = 11 + 14t - 2.0t^2$, where t is in seconds and x is in meters. Calculate the average velocity during the time interval from t = 1.0 s to t = 4.0 s.

$$x = 11 + 14 \cdot t - 2t^2$$

$$x_i = 11 + 14 \times 1 - 2 \times 1^2$$
$$= 25 - 2 = 23$$

$$x_f = 11 + 14 \times 4 - 2(4)^2$$
$$= 11 + 56 - 32$$
$$= 35$$

$$\bar{v} = \frac{x_f - x_i}{t}$$

$$= \frac{35 - 23}{3}$$

$$= \frac{12}{3} = 4\ m/s$$

Example Question 13

An object moves in a straight line according to the equation $x = 6t^2 - 10t - 6$, where x is in meters and t is in seconds. Calculate the velocity of the object, when the time is 4 seconds.

$$v = \frac{dx}{dt} = \frac{d}{dt}(6t^2 - 10t - 6)$$

$$v = 12t - 10$$

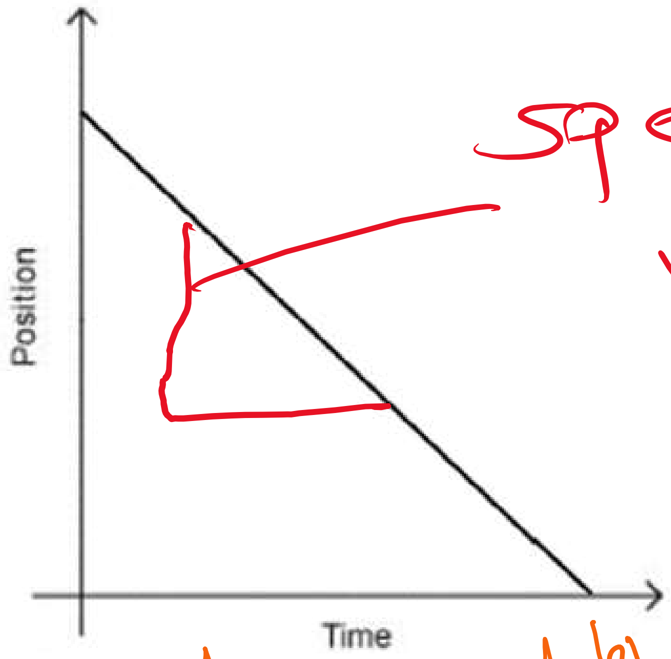
$$v(4) = 12(4) - 10$$

$$= 48 - 10$$

$$= \underline{38} \text{ m/s}$$

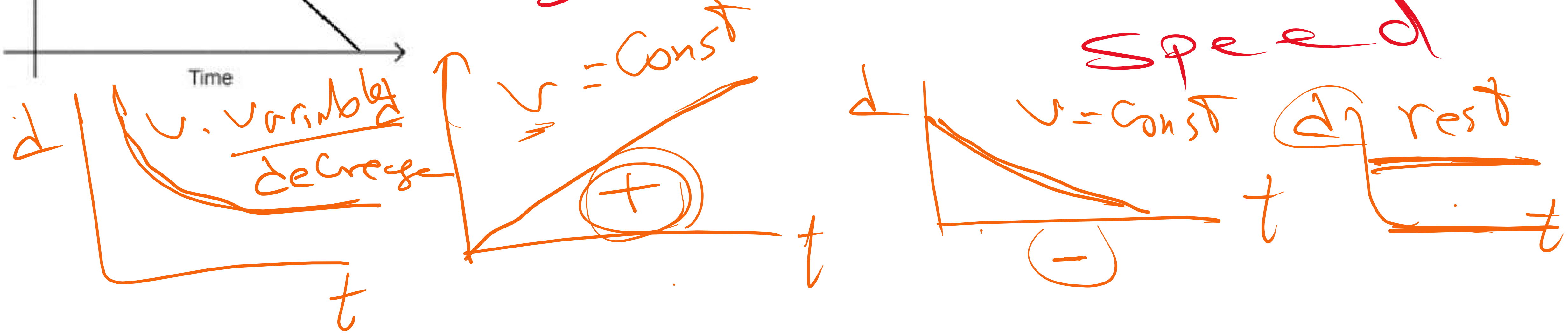
Example Question 14

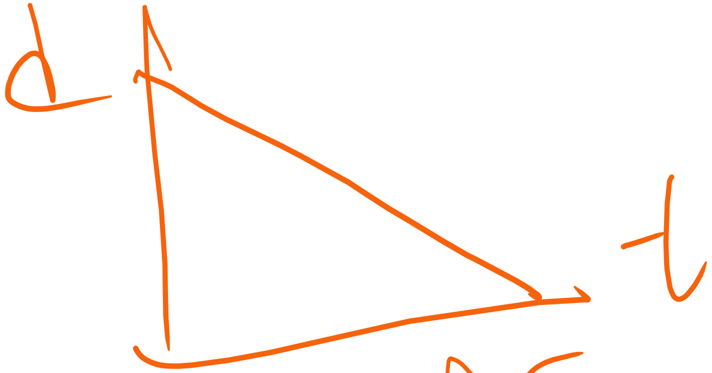
The position-time graph below, represents the motion of man. Describe the motion of the man in terms of speed, direction, and origin.



speed = slope = constant

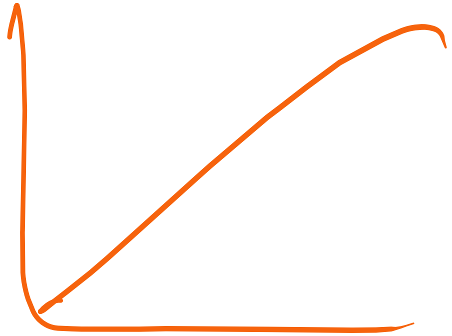
man is going toward origin at constant speed





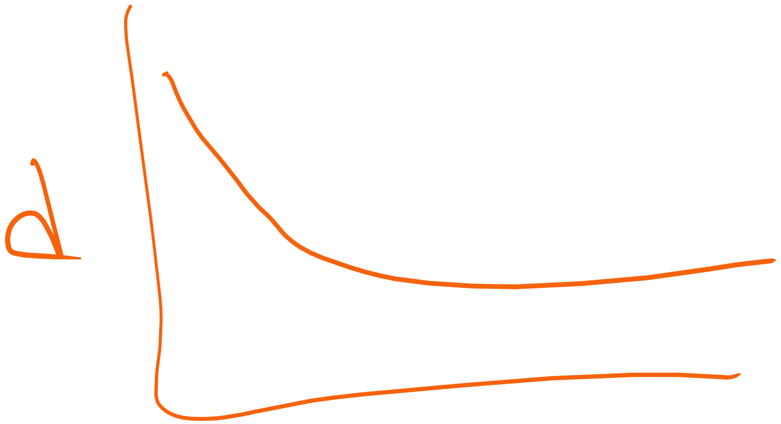
v

— Constant



+ve const

Rest



—ve acc

decrease
Variable

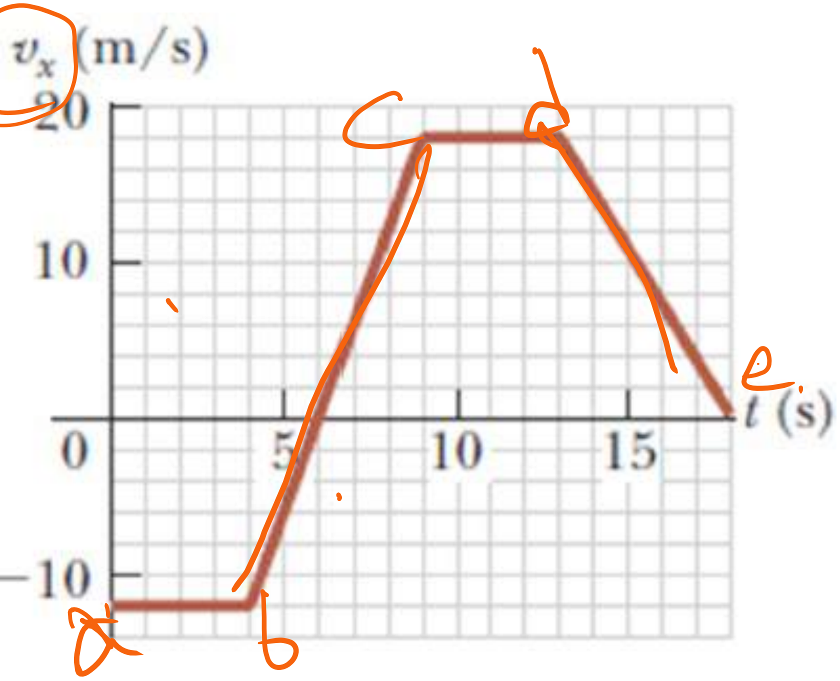
+ve acc

v increase

- Variable

Example Question 15

The velocity-time graph shown below, represents the motion of a car moving along a straight horizontal track. At what time does the velocity of the car change direction?



Velocity direction is related to the sign of slope.

Velocity direction positive from 4s to 9s then zero velocity then chang direction at 13 second.

V const. a-b / c-d

V varible b-c & d-e.

Example Question 16

A car moving in the x-direction has an acceleration a that varies with time as shown on the graph below. What is the change in velocity between t = 0 and t = 8 seconds?

c

$b = 8$

change in velocity = Area under a-t graph

$$\Delta v = A(\Delta) = \frac{b \times h}{2} = \frac{8 \times 6}{2}$$

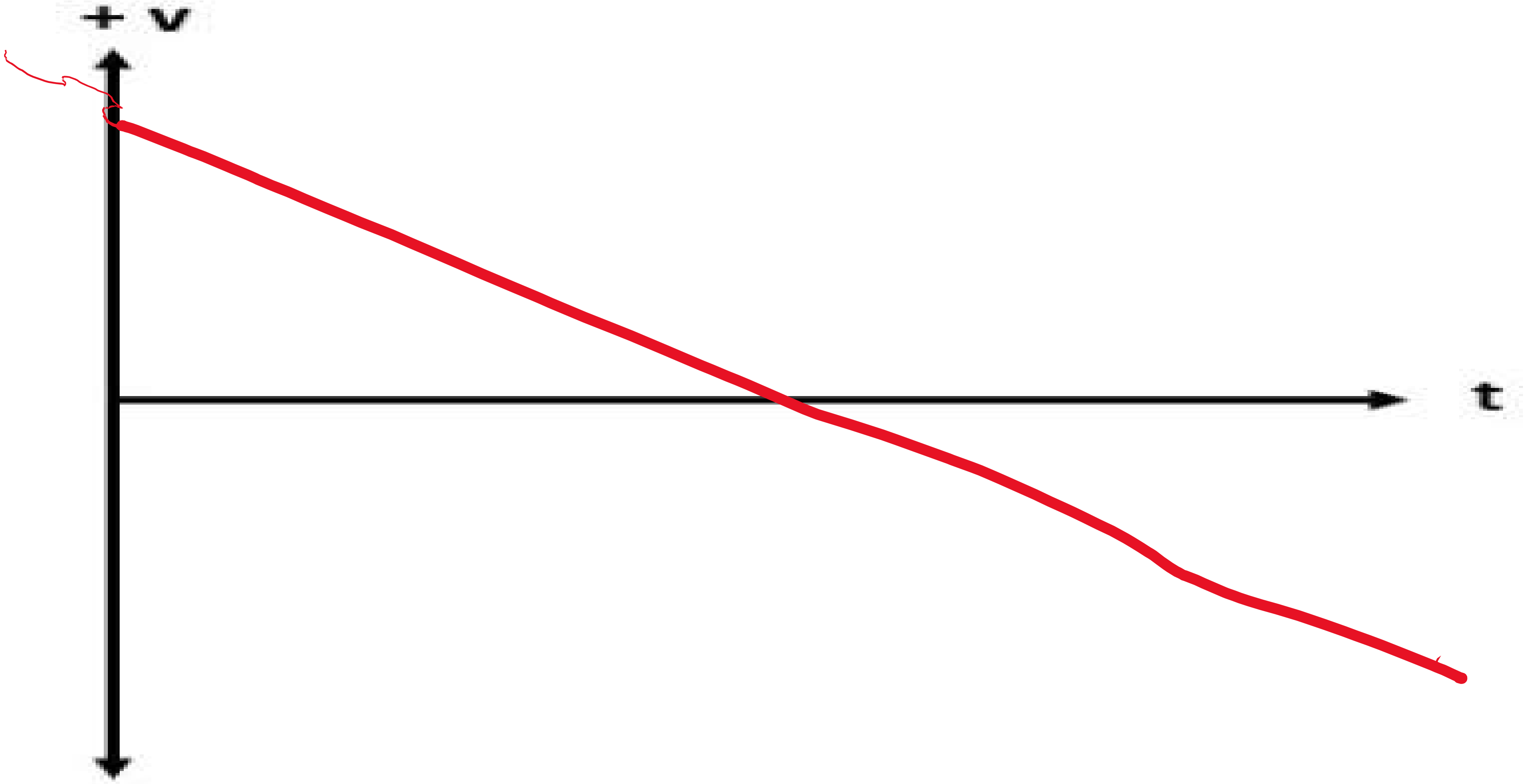
$$\Delta v = \frac{48}{2} = 24 \text{ m/s}$$

Example Question 17

The velocity as a function of time for a car on an amusement park ride is given as $v = At^2 + Bt$ with constants $A = 2.0\ m/s^3$ and $B = 1.0\ m/s^2$. If the car starts at the origin, what is its position at $t = 3.0\ s$?

Example Question 18

A ball is thrown up and returns to the same point. On the axes below draw the velocity–time graph that represents the motion of ball. (Assume that up direction is positive)



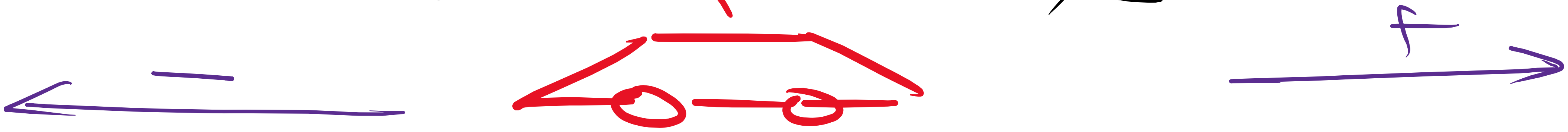
1. $v_f = v_o + at$
2. $x_f = x_o + v_o t + \frac{1}{2}at^2$
3. $v_f^2 = v_o^2 + 2a(x_f - x_o)$
4. $x_f = x_o + \frac{1}{2}(v_f + v_o)t$

Example Question 19

A car is traveling due west at 20.0 m/s. What is the velocity of the car after 37.00 s if its acceleration is 1.0 m/s^2 due east. Assume that the acceleration remains constant.

t

$\vec{v}_i = -20 \text{ m/s}$



$\vec{a} = 1 \text{ m/s}^2$

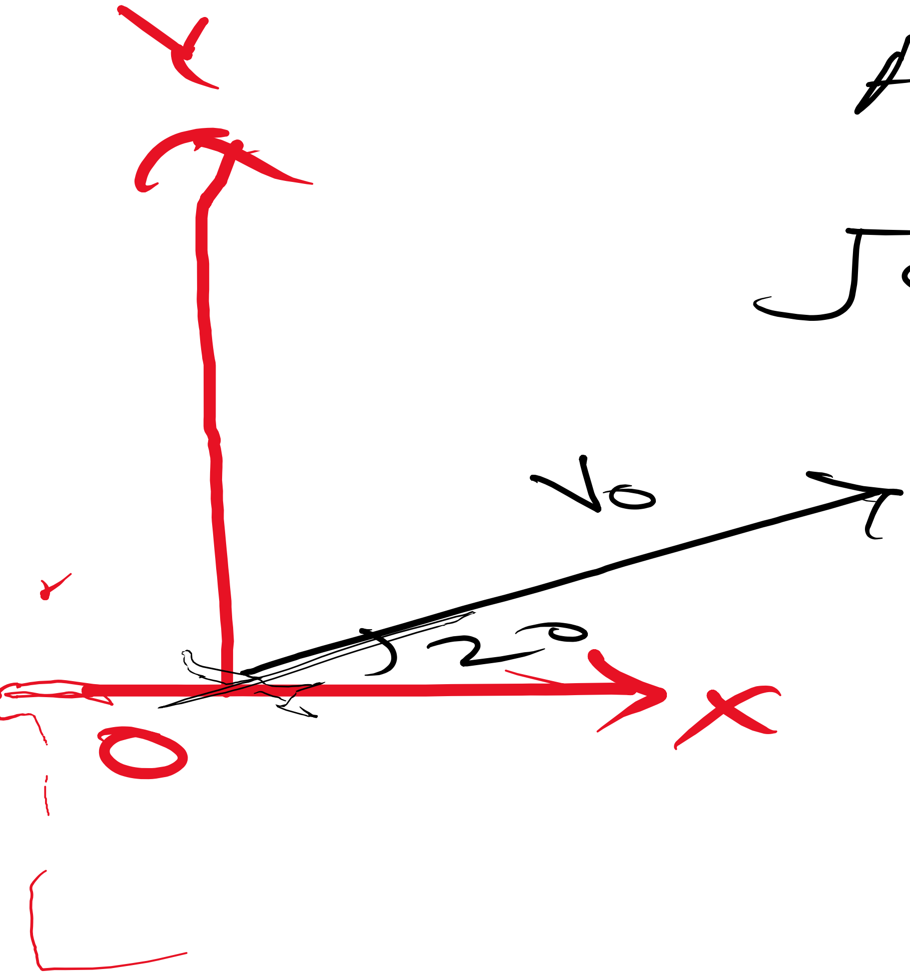
$$v_f = v_0 + at = (-20) + (1)(37)$$

$$= -20 + 37$$

$$= 17 \text{ m/s}$$

Example Question 20

A tennis ball is thrown into the air at an angle of 20° above the horizontal. What is the acceleration, magnitude, and direction, of the tennis ball just after it is released? (Neglect the effects of air resistance)



Acceleration = $g = 9.81 m/$

Just After realesed ball will go in x and y diriction with velocity

$$V = \sqrt{V_x^2 + V_y^2}$$

Example Question 21

A rabbit runs in a garden such that the x and y components of its displacement as functions of time are given by $x(t) = -0.45t^2 - 6.5t + 25$ and $y(t) = 0.35t^2 + 8.3t + 34$. What is the magnitude of the rabbit's velocity at t = 10.0 s. (Both x and y are in meters and t is in seconds.)

$$v_x = \frac{dx}{dt} = \frac{d}{dt}\left(-0.45t^2 - 6.5t + 25\right)$$

$$= -0.90t - 6.5$$

At 10 second

$$v_x(10) = -9 - 6.5 = -15.5 \text{ m/s}$$

$$v_y = \frac{dy}{dt} = \frac{d}{dt}\left(0.35t^2 + 8.3t + 34\right)$$

$$= 0.70t + 8.3$$

$$v_y(10) = 7 + 8.3 = 15.3 \text{ m/s}$$

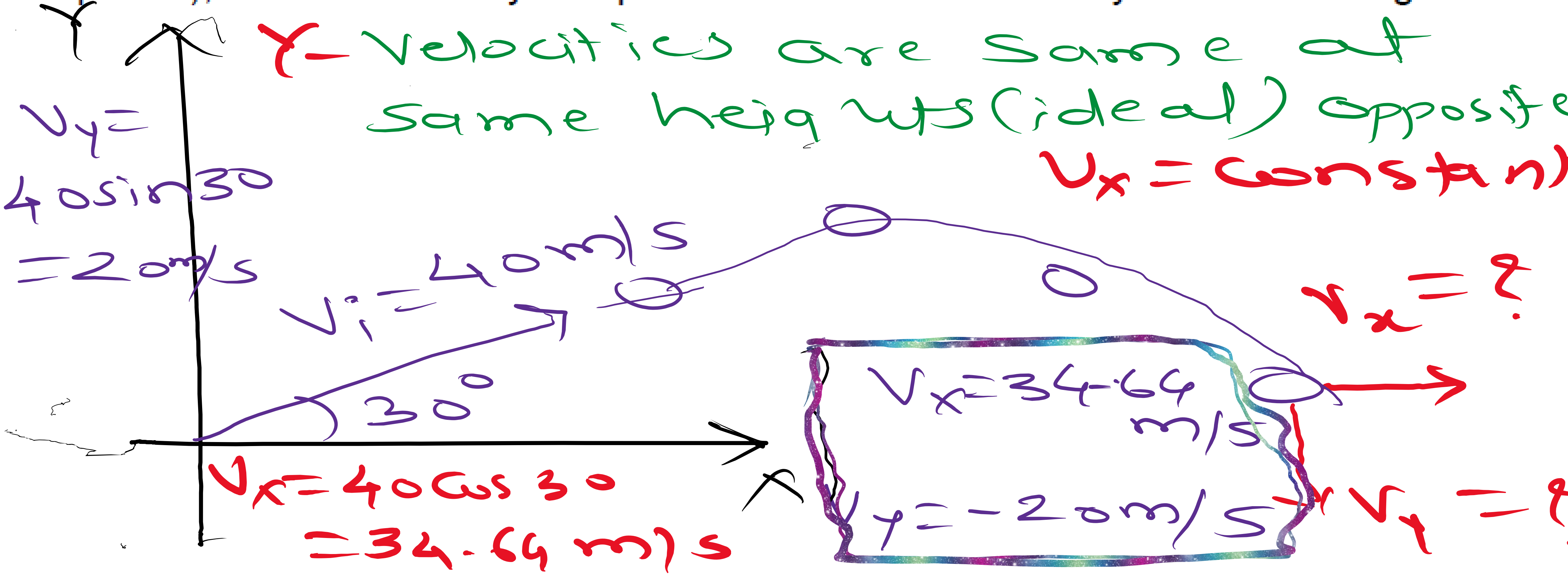
$$v = \sqrt{v_x^2 + v_y^2}$$

$$= \sqrt{(-15.5)^2 + (15.3)^2}$$

$$= 21.78 \text{ m/s}$$

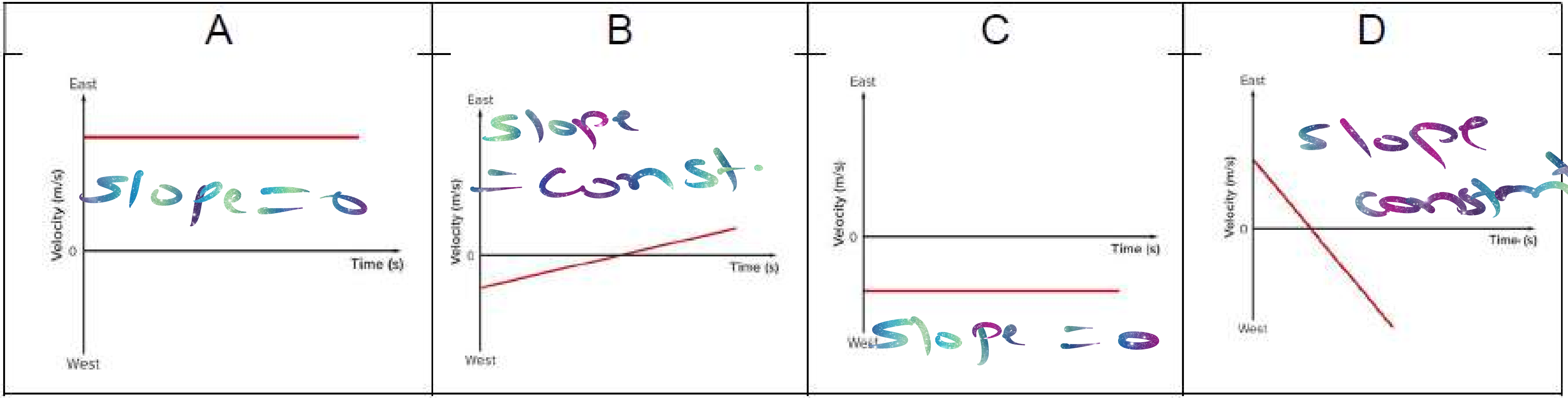
Example Question 22

A baseball is launched from the bat at an angle θ = 30.0° with respect to the positive x-axis and with an initial speed of 40.0 m/s, and it is caught at the same height from which it was hit. Assuming ideal projectile motion (positive y-axis upward), what are x and y components of the ball’s velocity when it is caught?



Example Question 23

The velocity-time graphs below represent the motion of 4 different objects, A, B, C, and D. Which object(s) move with constant and non-zero acceleration?



constant acceleration $\longrightarrow$ slope const

B and D

Example Question 24

The position of an object as a function of time is given as $x = At^3 + Bt^2 + Ct + D$. The constants are $A = 2.10\ m/s^3$, $B = 1.00\ m/s^2$, $C = -4.10\ m/s$, and $D = 3.00\ m$. Calculate the acceleration of the object at $t = 5.0\ s$.

$$v = \frac{dx}{dt} = \frac{d}{dt}(At^3 + Bt^2 + Ct + D)$$

$$v = 3At^2 + 2Bt + C$$

$$\bar{a} = \frac{dv}{dt} = \frac{d}{dt}(3At^2 + 2Bt + C)$$

$$= 6At + 2B$$

$$\boxed{a = 65\ m/s^2}$$

$\bar{a}$ at $t = 5\ s$

$$\bar{a} = 6(2.10)(5) + 2(1)$$

Example Question 25

A car slows down from a speed of 31.0 m/s to a speed of 12.0 m/s over a distance of 380 m. What is the value of this acceleration?

Δx

1. $v_f = v_o + at$
2. $x_f = x_o + v_o t + \frac{1}{2}at^2$
3. $v_f^2 = v_o^2 + 2a(x_f - x_o)$
4. $x_f = x_o + \frac{1}{2}(v_f + v_o)t$

$$\frac{v_f^2 - v_o^2}{2(\Delta x)} = \bar{a}$$

$$\bar{a} = \frac{12^2 - 31^2}{2(380)}$$

$$= -\frac{817}{760}$$

$$\boxed{a = -1.075\ m/s^2}$$

Thank You