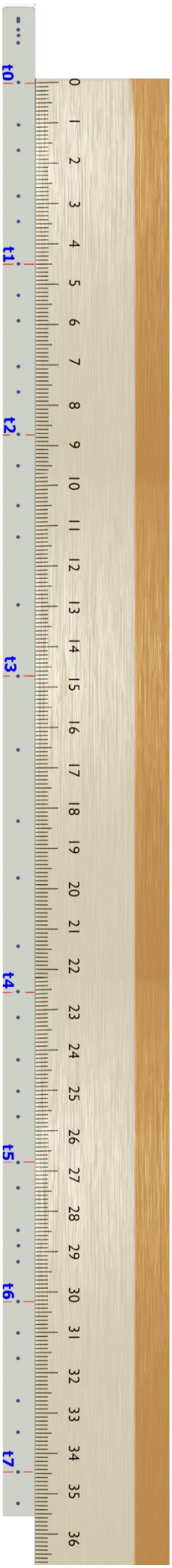
ElCoM
ELECTRICAL COMPUTER MECHATRONICS

تقدم لجنة ElCoM الاكاديمية

ريبورتات لمختبر :

الفيزياء العامة العملية

1 Use the given ticker tape for the data in your report



Kinematics of Rectilinear Motion

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Purpose: To study irregular motion of your hand, by determining how the distance, velocity and acceleration are changing with time.

A. Fill in **table (1)** with data from **your tape**. Then, draw a graph of **x** versus **t** .

B. Use data from **table (1)** to fill **table (2)** . Then, draw a graph of $\bar{v}$ versus **t** . Then, draw the curve of the **instantaneous velocity**. {Assume that the instantaneous velocity at the interval's mid-point equals the average velocity in that interval, and that the acceleration is constant between each two intervals.}

C. Use data from **table (1)** to fill in **table (3)** .

Table(1)

Total time t (sec)	Total distance x (cm)
0.0	0.0
0.1	4.5
0.2	8.7
0.3	14.7
0.4	22.5
0.5	26.8
0.6	30.2
0.7	34.5

Table(2)

Time interval (s)	Average velocity $\bar{v} = \frac{\Delta x}{\Delta t}$ (cm/s)
0.0 – 0.1	45
0.1 – 0.2	42
0.2 – 0.3	60
0.3 – 0.4	78
0.4 – 0.5	43
0.5 – 0.6	34
0.6 – 0.7	34

Table (3)

t_{mid} (s)	$v_{mid} \cong \bar{v}$ (cm/s)	$\bar{a} = \frac{\Delta v}{\Delta t}$ (cm/s^2)
0.05	45	
		-30
0.15	42	
		180
0.25	60	
		180
0.35	78	
		-350
0.45	43	
		-90
0.55	34	
		0
0.65	34	

Use **(*x*-*t*) graph** to answer the following questions:

a) Determine **one** interval in which:

1- The velocity is increasing: [0 , 0.4] & [0.6 , 0.7]

2- The velocity is decreasing: [0.4 , 0.6]

3- The velocity is constant: [0 , 0.2]

b) Find the instantaneous velocity at **t = 0.4 s** from the **slope** of the tangent of the **(x-t)** graph.

$$V_{ins} = \frac{\Delta x}{\Delta t} = \frac{29 - 16}{0.5 - 0.3} = 65\ cm/s$$

Fill in **table (4)** below using data from **table(1)**, and then answer the following questions:

Table (4)
Average velocity $\bar{v} = \frac{\Delta x}{\Delta t}$ (cm/s)
$\bar{v}_{7-1} = \frac{x_7 - x_1}{t_7 - t_1} = 50$
$\bar{v}_{6-2} = \frac{x_6 - x_2}{t_6 - t_2} = 53.75$
$\bar{v}_{5-3} = \frac{x_5 - x_3}{t_5 - t_3} = 60.5$

c) The **midpoint** for the given intervals is $\mathbf{t_{mid}}$ = 0.4 s.

d) As the time interval is shortened, is there any relation between average velocities in **table (4)** and instantaneous velocity at the midpoint? Yes, when (t = 0.4 s.) , $V_{(At\ midpoint)} \approx V_{(5\text{-}3)}$

e) Write down the approximate instantaneous velocity at $\mathbf{t_{mid}}$ from table (4).

$V_{(At\ midpoint)}$ = 65 cm/s

f) Compare this result with that you have found in **question (b)** above?

Use (***v-t***) **graph** to answer the following questions:

g) Determine **one** interval in which the acceleration is **positive** : [0.15 , 0.35]

h) Find the instantaneous velocity at **t = 0.4 sec** from the graph. 63 cm/s.

i) And compare it with the result in **question (b).**

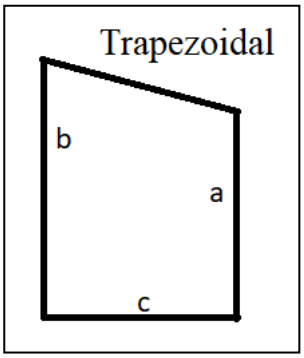
$$P.E = \left(\frac{|63 - 65|}{\left(\frac{(66 + 65)}{2}\right)} \right) \times 100\% = 3.125\%$$

j) Calculate the area under the **instantaneous velocity** in the interval [**0.2-0.4] sec**.

Now we divide the carve into 2 sections.

First section from [0.2 , 0.35] (Trapezoidal)

Second section from [0.35 , 0.4] (Trapezoidal)



$$\text{Trapezoidal Area} = \frac{(a + b)}{2} \times c$$

Now, I want calculate area.

x = Area for first section + Area for second section

$$x = \left(\frac{(78 + 42)}{2} \times 0.15\right) + \left(\frac{(78 + 63)}{2} \times 0.05\right) = 12.525$$

k) What does this area represent? This area represents the distance traveled.

l) Compare it with the distance moved in the interval [**0.2-0.4] sec** from **table (1).**

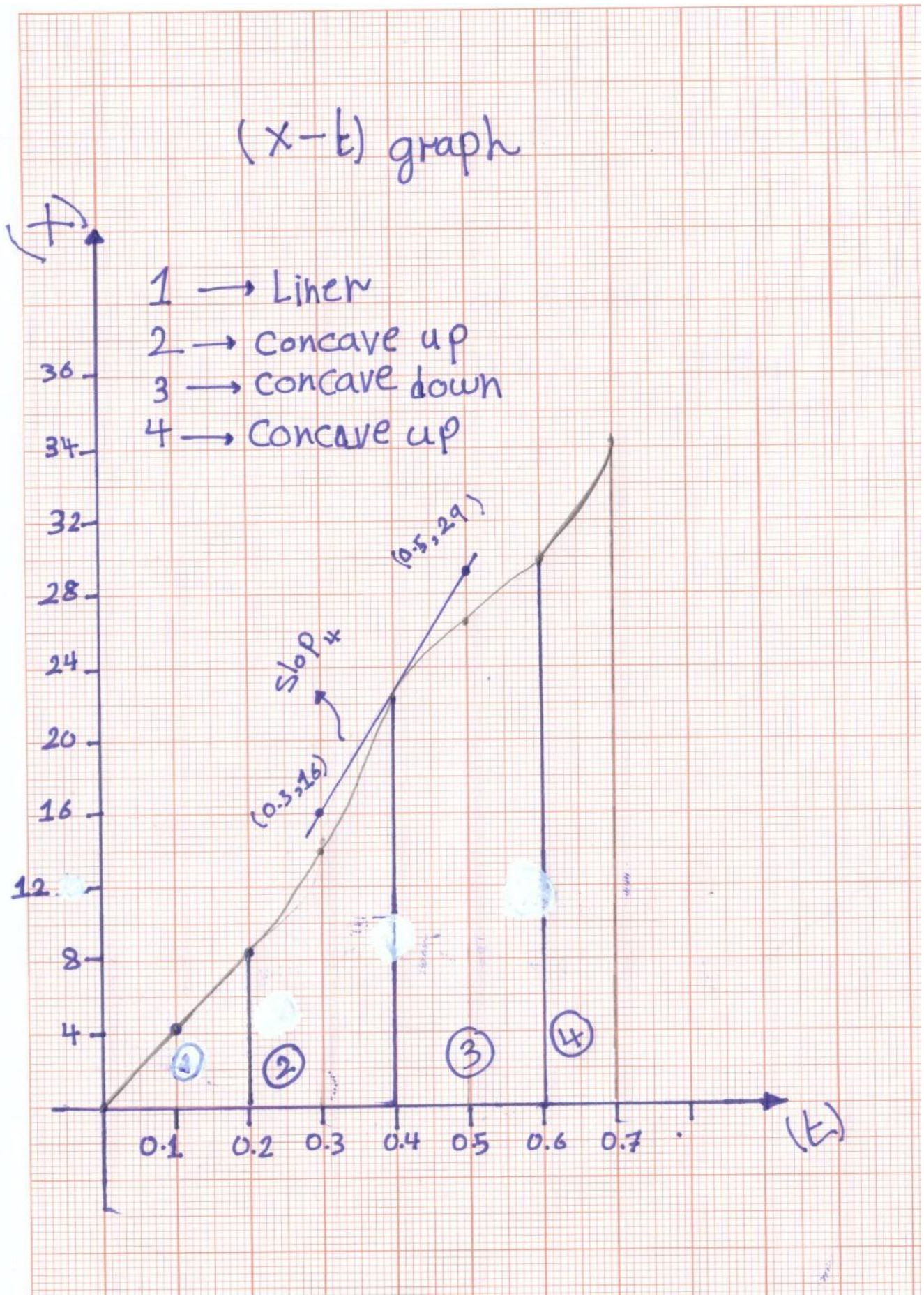
From table (1) : distance moved = 22.5 – 8.7 = 13.8 cm.

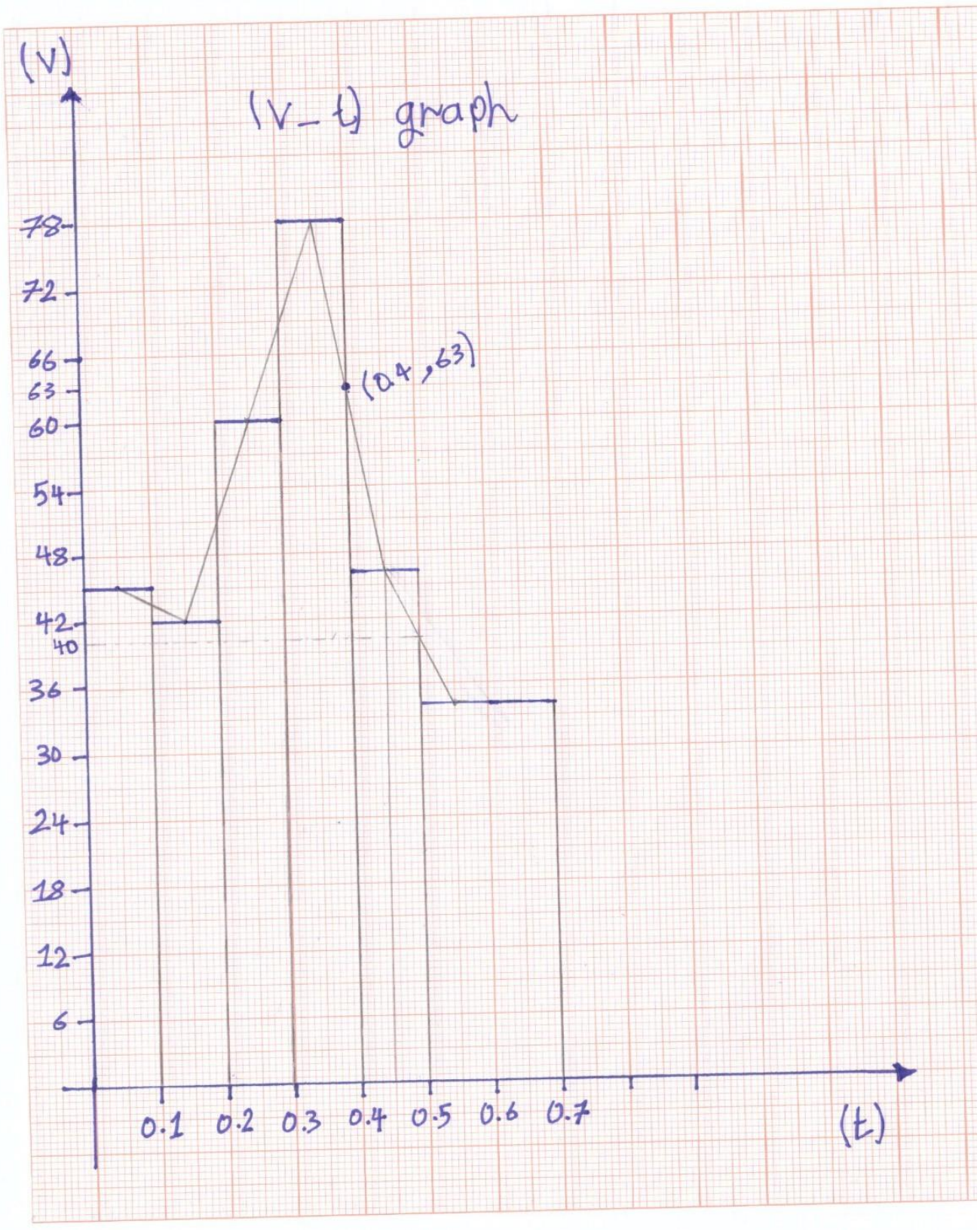
now we want to calculate P.E.

$$P.E = \left(\frac{|13.8 - 12.525|}{\left(\frac{(13.8 + 12.525)}{2}\right)}\right) \times 100\% = 9.7\%$$

Use ***Table (3)*** to answer the following questions:

n) How does the acceleration change from one interval to the other (is it uniform or irregular)? Its irregular.


(x-t) graph
(x)
1 → Liner
2 → Concave up
3 → Concave down
4 → Concave up
36
34
32
28
24
20
16
12
8
4
(0.5,29)
slope
(0.3,16)
1
2
3
4
0.1
0.2
0.3
0.4
0.5
0.6
0.7
(t)


(V)
(V-t) graph
78
72
66
63
60
54
48
42
40
36
30
24
18
12
6
(0.4, 63)
0.1
0.2
0.3
0.4
0.5
0.6
0.7
(t)