

Exp 2 Newton's Second law of Motion

Aim

To study the motion of objects using Newton's Second law.

Apparatus

Toy cart, weight, pulley, stopwatch

Formulas used

$$F = ma_{\text{cart}} \quad - (1)$$

~~$$F = ma_{\text{cart}} \quad - (2)$$~~

$$T = ma_{\text{cart}} + \mu mg \quad - (2)$$

$$Mg - T = Ma_{\text{mass}} \quad - (3)$$

$$T = \frac{m(Mg - \mu mg)}{m + m} + \mu mg \quad - (4)$$

$$S = \frac{1}{2} at^2 \quad - (5)$$

<u>Mass of the cart</u> (m) (g)	<u>Mass of the weight M(g)</u>	<u>Time taken by cart to travel distance, t</u> (sec)	<u>Acceleration (a)</u> from 2 (m/s ²)	<u>Tension (T) (g m/s²)</u>	<u>Distance travelled (s) from slope (cm)</u>	<u>Percentage error</u>	<u>Average percentage error</u>
10	1	1:51	87.36	893.28	99.5	0.81	0.5
20		2:11	44.82	935.82		1.5	
30		2:59	29.73	950.91		0.2	
40		3:02	22.00	958.65		0	
50		3:40	17.30	963.34		0.3	
30	2	1:83	59.45	1842.40	97.87	0.81	1.18
	4	1:33	113.64	3468.05		4.4	
	6	1:11	161.81	4913.08		0.63	
	8	0:99	204.91	6205.99		0.01	
	10	0:91	243.69	7369.62		0.09	

Calculations

⇒ for acceleration:

$$(i) a = \frac{1 \times 9.8 - 0.002 \times 10 \times 9.8}{1 + 10} = 87.36 \text{ cm/s}^2$$

$$(ii) a = \frac{1 \times 9.8 - 0.002 \times 30 \times 9.8}{1 + 30} = 29.73 \text{ cm/s}^2$$

$$(iii) a = \frac{30 \times 9.8 - 0.002 \times 4 \times 9.8}{30 + 4} = 113.64 \text{ cm/s}^2$$

⇒ for Tension

$$T = \frac{m(\mu g - \mu mg)}{m + m} + \mu mg$$

① $m = 10, \mu = 1$

$$T = \frac{10(1 \times 9.8 - 0.002 \times 10 \times 9.8)}{10 + 1} + 0.002 \times 10 \times 9.8$$
$$= 893.28 \text{ g cm/s}^2$$

② Similarly, $m = 40, \mu = 1$

$$\Rightarrow T = 958.65 \text{ g cm/s}^2$$

$$\textcircled{3} \quad m=30, k=8$$

$$\Rightarrow T = 6205.99 \text{ cm/s}^2$$

$$s = \frac{\Delta y}{\Delta n} = \frac{143 - 81}{0.69 - 0.38} = 99.3 \text{ cm} \quad (\text{By graph})$$

$$\Rightarrow s \text{ by } \frac{1}{2} at^2 = \frac{1}{2} \times 87.36 \times 1.51^2 = 99.5 \text{ cm}$$

$$\Rightarrow s \text{ by } \frac{1}{2} at^2 = 97.87 \text{ cm}$$

percentage error

$$\Rightarrow \frac{100.31 - 99.5}{99.5} \times 100 = 0.81\%$$

$$\Rightarrow \frac{100.31 - 100.41}{100.41} \times 100 = 0.09\%$$

Results and conclusion

The acceleration and tension of the cart with different weights is shown in the table with percentage error.

