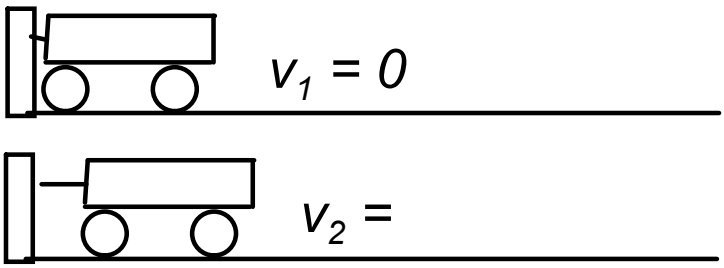
Problem solving steps for:

force/motion problems



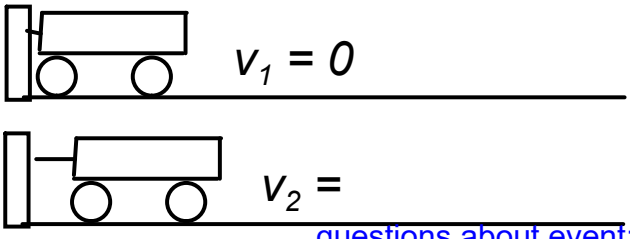
$m_c = 525$ g

$F_a = ?$

1) bare cart

2) +500 g

3) +1000 g



$m_c = 525$ g

$F_a = ?$

1) bare cart

event: acceleration cart

data

$m_c = 525$ g
→ .525 kg
→ $F_w = -5.15$ N

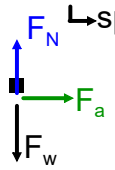
$v_1 = 0$
$v_2 = 1.6$ m/s
d = 2.6 cm
→ .026 m

questions about event:

PM - X
TM - accel

obj - cart

env. → earth - F_w
→ surf. - F_N
→ spring - F_a



"T"chart

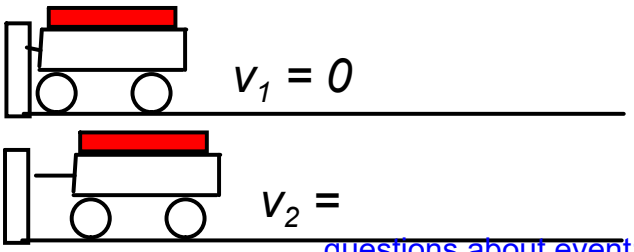
∥	⊥
TM - accel	TM - rest
2nd - ΣF = ma	1st - ΣF =0
F_a = ma	$F_w + F_N = 0$
	$F_N = -(F_w)$
	$F_N = -(-5.15N)$
	$F_N = +5.15N$

F_a = ,525 kg(49.2 m/s^2)

$F_a = 25.8$ N

$a = v_2^2 - v_1^2 / 2d$ a
$a = [(1.60 \text{ m/s})^2 - 0]/[2(.026\text{m})]$

$a = 49.2$ m/s^2



$m_c = 525$ g

$F_a = ?$

event: acceleration cart

1) bare cart

data

$m_c = 525$ g
→ .525 kg
→ $F_w = -5.15$ N

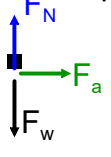
$v_1 = 0$
$v_2 = 1.6$ m/s
d = 2.6 cm
→ .026 m

questions about event:

PM - X
TM - accel

obj - cart

env. → earth - F_w
→ surf. - F_N
→ spring - F_a



"T"chart

∥	⊥
TM - accel	TM - rest
2nd - ΣF = ma	1st - ΣF =0
F_a = ma	$F_w + F_N = 0$
	$F_N = -(F_w)$
	$F_N = -(-5.15N)$
	$F_N = +5.15N$

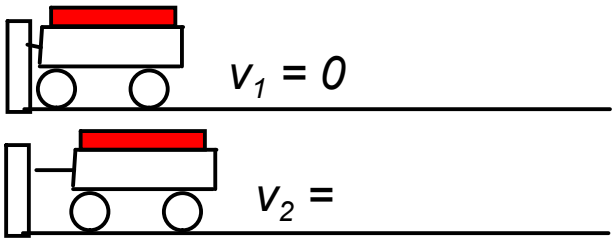
F_a = ,525 kg(49.2 m/s^2)

$F_a = 25.8$ N

If 500 g mass added to cart what changes?

$a = v_2^2 - v_1^2 / 2d$ a
$a = [(1.60 \text{ m/s})^2 - 0]/[2(.026\text{m})]$

$a = 49.2$ m/s^2



$m_c = 525$ g

$F_a = ?$

∥	⊥
TM - accel	TM - rest
2nd - $\Sigma F = ma$	1st - $\Sigma F = 0$
$F_a = ma$	$F_w + F_N = 0$
	$F_N = -(F_w)$
	$F_N = -(-5.15N)$
	-10.0 N
	$F_N = +5.15N$
	+10.0 N

2) bare cart

+500 g mass

What Changes?

$v_2 = 1.1$ m/s

PM - X

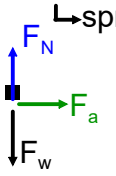
TM - accel

obj - cart

env. → earth - F_w

↳ surf. - F_N

↳ spring - F_a



data

m_c = 525 g --1025 g

↳ 525 kg 1.025 kg

↳ F_w = -5.15 N -10.0 N

$v_1 = 0$

v_2 = 1.6 m/s --- 1.1 m/s

d = 2.60 cm

↳ .026 m

F_a = 1.025 kg(49.2 m/s^2) 23.3 m/s^2

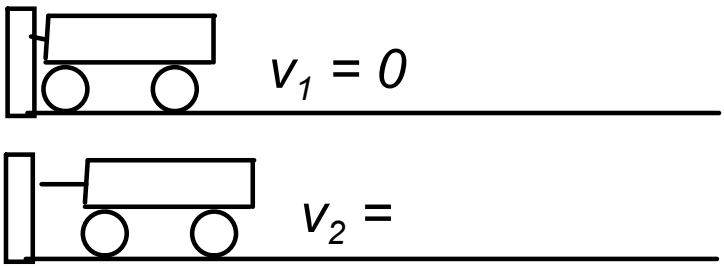
F_a = 25.8 N --- 23.9 N

$a = v_2^2 - v_1^2 / 2d$ a

$a = [(1.60 \text{ m/s})^2 - 0]/[2(.0260\text{m})]$

1.10 m/s

a= 49.2 m/s^2 23.3 m/s^2



$m_c = 525$ g

1) bare cart

$v_2 = 1.60$ m/s ... a = 49.2 m/s^2 ... $\Sigma F = .525$ kg(49.2 m/s^2) = 25.8 N

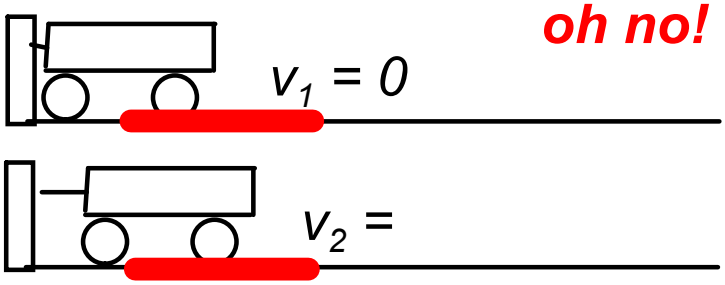
$a = v^2 2d = (1.60 \text{ m/s}^2)/[2(.026\text{m})] = 49.2 \text{ m/s}^2$

2) +500 g

$v_2 = 1.10$ m/s ... a = 23.3 m/s^2 ... $\Sigma F = 23.9$ N

3) +1000 g

$v_2 = 0.93$ m/s ... a = 16.6 m/s^2 ... $\Sigma F = 25.4$ N

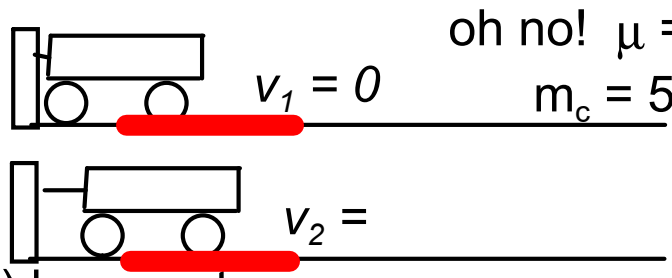


1) bare cart

v_2 = 1.30 m/s instead of 1.60 m/s

2) +500 g

3) +1000 g



1) bare cart

event: acceleration cart

data

m_c = 525 g → .525 kg → F_w = -5.15 N

v_1 = 0

v_2 = 1.30 m/s

d = 2.60 cm → .0260 m

questions about event:

PM - X

TM - accel

obj - cart

env. → earth - F_w

↳ surf. - F_N

↳ spring - F_a

↳ sur/obj - F_f

"T" chart

∥	⊥
TM - accel	TM - rest
2nd - ΣF = ma	1st - ΣF =0
$F_f + F_a = ma$	$F_w + F_N = 0$
$F_f = ma - F_a$	$F_N = -(F_w)$
	$F_N = -(-5.15N)$
	$F_N = +5.15N$

F_f = .525 kg(32.5 m/s^2) - (25.8N)

F_f = -8.74 N

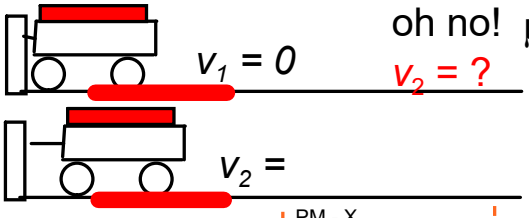
$\mu = F_f/F_w$

μ = -8.74N/5.15N

μ = 1.70

a = 32.5 m/s^2 ... ΣF = .525 kg(32.5 m/s^2) = 17.1 N

a = v^2/2d = (1.30 m/s^2)/[2(.0260m)] = 32.5 m/s^2



oh no! $\mu =$ _____
$v_2 = ?$ $m_c = 525$ g

2) bare cart
+ 500 g

What changes?

data

$m_c = 525$ g --1025 g
→525 kg 1.025 kg
→$F_w = -5.15$ N -10.0 N

$v_1 = 0$
$v_2 = 1.60$ m/s --- ___ m/s?
d = 2.60 cm
→0260 m

$\mu = 1.70$
$F_a = 25.8$ N

a = ?

PM - X
TM - accel

obj - cart

env. earth - F_w
surf. - F_N
spring - F_a
sur/obj - F_f

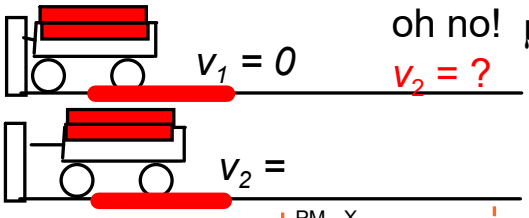
$\mu = F_f/F_N$
$F_f = \mu F_N$
$F_f = 1.70(10.0\text{N})$
$F_f = -17.0$N

∥	⊥
TM - accel	TM - rest
2nd - $\Sigma F = ma$	1st - $\Sigma F = 0$
$F_f + F_a = ma$	$F_w + F_N = 0$
$a = F_f + F_a/m$	$F_N = -(F_w)$
	$F_N = -(-5.15\text{N})$ -(-10.0N)
	$F_N = +5.15$N +10.0 N

$a = (-17.0\text{N} + 25.8\text{N})/1.025$ kg
$a = 8.58$ m/s^2

$v_2 = 1.30$ m/s

$v_2^2 = v_1^2 + 2ad$
$v_2 = \sqrt{2(8.58\ m/s2)(.0260\ m)}$
$v_2 = 0.667$ m/s



oh no! $\mu =$ _____
$v_2 = ?$ $m_c = 525$ g

3) bare cart
+ 1000 g

What changes?

data

$m_c = 525$ g --1025 g
→525 kg 1.025 kg
→$F_w = -5.15$ N -10.0 N

$v_1 = 0$
$v_2 = 1.60$ m/s --- ___ m/s?
d = 2.60 cm
→0260 m

$\mu = 1.70$
$F_a = 25.8$ N

a = ?

PM - X
TM - accel

obj - cart

env. earth - F_w
surf. - F_N
spring - F_a
sur/obj - F_f

$\mu = F_f/F_N$
$F_f = \mu F_N$
$F_f = 1.70(10.0\text{N})$
$F_f = -17.0$N

∥	⊥
TM - accel	TM - rest
2nd - $\Sigma F = ma$	1st - $\Sigma F = 0$
$F_f + F_a = ma$	$F_w + F_N = 0$
$a = F_f + F_a/m$	$F_N = -(F_w)$
	$F_N = -(-5.15\text{N})$ -(-10.0N)
	$F_N = +5.15$N +10.0 N

$a = (-17.0\text{N} + 25.8\text{N})/1.025$ kg
$a = 8.58$ m/s^2

$v_2 = 1.30$ m/s

$v_2^2 = v_1^2 + 2ad$
$v_2 = \sqrt{2(8.58\ m/s2)(.0260\ m)}$
$v_2 = 0.667$ m/s