SEMI & SEMI II
MIXED REX #2

KEY
2/27
PER XX
MR. II

1.

INIT

$p_i = 5$ kg m/s

FINAL

$p_f = 5$ kg m/s

since $p_{PPb} + p_{BB} = 5$

$p_{BB} > \emptyset$

$p_{PPb} < \emptyset$

(i.e. it is negative)

$\therefore p_{BB} > 5$

(D.)

2.

$a = 10\ m/s^2$ at all points

(C)

3.

Tension in rope is 300 N. If cut in half would need 300 N reaction force against pulling man to be in equilibrium.

(B)

4. $p = mv$

a, c have $\emptyset$

b is slow, so small

e has small m, so small

d (pick-up) has m & v.

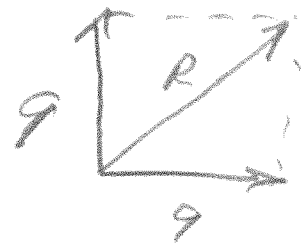
(D)

5. Scalar quantities have <u>magnitude</u>

(B)

6. Projectile has minimum speed at <u>top of arc</u>.

(C)

7. 

$R = \sqrt{a^2 + b^2}$

$= \sqrt{9^2 + 9^2}$

$= \sqrt{162}$

$\approx$ **13 UNITS**

(C)

8. $a = \frac{\Delta v}{t}$

$= \frac{\emptyset}{3}$ (NO CHANGE IN v)

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

(A)

9. 

$0\ m/s$ → $42\ m/s$

$t = 7\ sec$

Find a

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

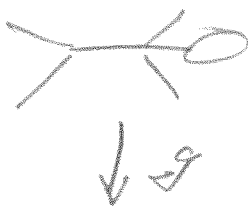
$$= \frac{42\ m/s - 0\ m/s}{7\ s}$$

(C) $\boxed{a = 6\ m/s^2}$

10. Objects fall at constant acceleration ($10\ m/s^2$)

(C)

11.

(B) 

Earth pulls Bronco

Bronco pulls Earth

12. 120 km in 2 hrs.

$$s = \frac{d}{t}$$

(D) $$= \frac{120\ km}{2\ hrs}$$

$\boxed{s = 60\ km/hr}$

13.

$v = v_0 + at$

$= 0 + (10\ m/s^2)(1.5\ s)$

(B) $\boxed{v = 15\ m/s}$

14.

$p = mv$

$= (10\ kg)(3\ m/s)$

(C) $\boxed{p = 30\ kg\ m/s}$

15.

$p = 12.0\ kg\ m/s$

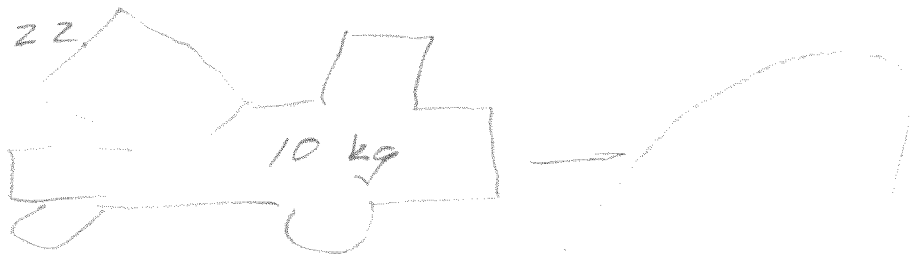
$p = mv$

$\frac{p}{m} = v$

$v = \frac{12.0\ kg\ m/s}{3.0\ kg}$

(B) $\boxed{v = 4.0\ kg\ m/s}$

22.



$v_i = 4\ m/s$ $\qquad$ $v_f = 0\ m/s$

What is F_{AVE} on Bank?

Impulse Problem! (Leno's favorite)

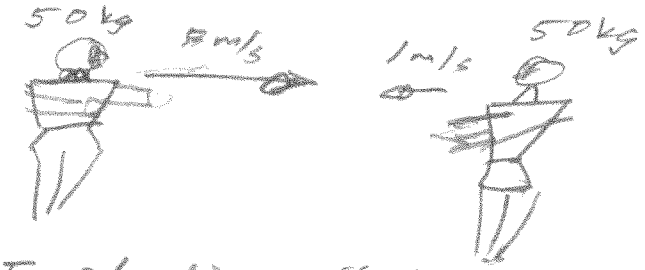
$$F \cdot t = \Delta m v$$

$$F = \frac{\Delta m v}{t}$$

$$= \frac{(10\ kg)(4\ m/s)}{2\ s}$$

$$\boxed{F = 20\ N}$$

23.



Define right = positive v

Inelastic collision

$$p_i = p_f$$

$$m_1 v_{1,i} + m_2 v_{2,i} = v_f (m_1 + m_2)$$

or

$$\frac{m_1 v_{1,i} + m_2 v_{2,i}}{m_1 + m_2} = v_f$$

$$v_f = \frac{(50\ kg)(8\ m/s) + (50\ kg)(-1\ m/s)}{50\ kg + 50\ kg}$$

$$\boxed{v_f = 3.5\ m/s \quad (+ \text{ to right})}$$

24.

INIT (9kg) → 4 m/s

FINAL ← (9kg) 4m/s

Find Δp (momentum)

$\Delta p = p_f - p_i$

$= (9\,kg)(4\,m/s) - (9\,kg)(-4\,m/s)$

$\boxed{\Delta p = 72\ kg\ m/s}$

25.

Explosion Collision

$p_i = p_f$

$0 = m_g v_g + m_b v_b$

$m_g v_g = -m_b v_b$

$v_g = \frac{-m_b v_b}{m_g}$

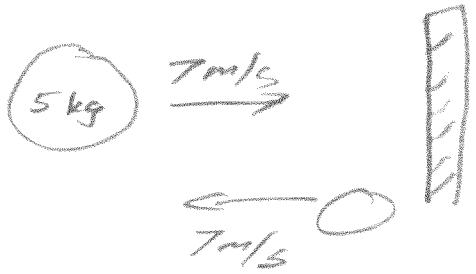
$= \frac{-(30\,kg)(3\,m/s)}{45\,kg}$

$\boxed{v_g = 2.0\ m/s}$

(Actually negative but problem asks speed so always positive)

Answers

26.



Impulse to wall?

$Imp = \Delta mv$

$= p_f - p_i$ NOTICE!

$= (5kg)(7m/s) - (5kg)(-7m/s)$

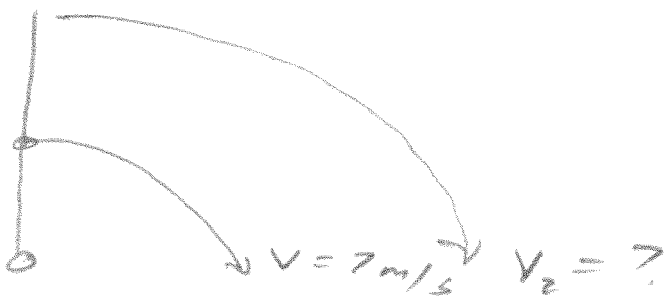
$\boxed{I = 70\ kg\ m/s}$ OR $70\ N\cdot s$

27.

9 RPM

Rotational speed is the same everywhere so $\boxed{9\ RPM}$

28.



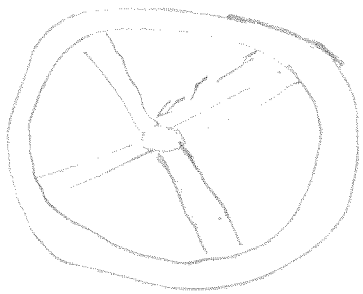
$V_T = r\omega$

$\frac{V_{T2}}{V_{T1}} = \frac{2r\omega}{r\omega}$

$V_{T2} = (7m/s)(2)$

$\boxed{V_{T2} = 14\ m/s}$

29.



$r_1 = 200m$; $a_{c1} = g$

$$a_c = \frac{v_T^2}{r}$$

Find a_c @ 100m

$$F_c = \frac{mv^2}{r}$$

$$F = ma$$

$$a_c = \frac{F}{m}$$

$$a_c = \frac{v^2}{r}$$

$$\frac{a_{c2}}{a_{c1}} = \frac{v_2^2/r_2}{v_1^2/r_1}$$

but $v_T = r\omega$

so

$$\frac{a_{c2}}{a_{c1}} = \frac{(r_2\omega)^2/r_2}{(r_1\omega)^2/r_1} \quad (\omega \text{ CANCELS})$$

$$\frac{a_{c2}}{a_{c1}} = \frac{r_2}{r_1}$$

$$a_{c2} = g\,(100m/200m)$$

$$\boxed{a_{c2} = 1/2\, g}$$

30. Heat 50g H_2O by 20°C?

$$Q = mc\Delta T$$

$$= (50g)\left(\frac{1\,cal}{g°C}\right)(20°C)$$

$$\boxed{Q = 1000\,cal}$$

31. Heat 1 ℓ H_2O 15°C; what if some Q to 5 ℓ H_2O?

$Q = m_1 c \Delta T_1$

SAME Q so:

$$(5\,\ell)\left(\frac{1000g}{1\,\ell}\right)\left(\frac{1\,cal}{g°C}\right)\Delta T = (1\,\ell)\left(\frac{1000g}{1\,\ell}\right)\left(\frac{1\,cal}{g°C}\right)(15°C)$$

$$\Delta T = \frac{15}{5}°C$$

$$\boxed{\Delta T = 3°C}$$

32. 92g Fe bar @ 150°C

200g H_2O INTO @ 22°C

Find T_F

$$m_{Fe} c_{Fe} \Delta T_{Fe} = m_{H_2O} c_{H_2O} \Delta T_{H_2O}$$

$$(92g)\left(0.11 \frac{cal}{g°C}\right)(150°C - T_F) = (200g)\left(1 \frac{cal}{g°C}\right)(T_F - 22°C)$$

DISTRIBUTE $1518 - 10.12 T_F = 200 T_F - 4400$

RE-ARRANGE $1518 + 4400 = (200 + 10.12) T_F$

SOLVE $\boxed{T_F = 28.2°C}$

AWAD

33. Find 2x K.E. from 38°C

① Convert to Kelvin

$38°C + 273 = 311 K$

② DOUBLE

$311 K * 2 = 622 K$

③ CONVERT TO °C

$622 K - 273 = \boxed{349°C}$

34. $T_{Hot} = 22°C$, $T_{Cold} = 5°C$

Find $Eff = \frac{T_{Hot} - T_{Cold}}{T_{Hot}}$

CONVERT TO KELVIN

$22°C + 273 = 295 K$

$5°C + 273 = 278 K$

$$Eff = \frac{295K - 278K}{295K}$$

$\boxed{Eff = 6\%}$

35. What is weight multiplied by if $m_e = \frac{1}{4}$ today and r = same

$$\frac{F_{G2}}{F_{G1}} = \frac{G\dfrac{m_1 \frac{1}{4} m_e}{r^2}}{G\dfrac{m_1 m_e}{r^2}}$$

$$\boxed{\frac{F_{G2}}{F_{G1}} = \frac{1}{4}}$$

36. $m = 60\ kg$ everywhere

$$\boxed{m = 60\ kg}$$

37. $m = 60\ kg$ height = earth's diameter

$$F_G = G\frac{m_1 m_2}{r^2}$$

What is r?

$$r_{act} = r_{earth}\text{(earth's radius)} + 2r_{earth}\text{(diameter)}$$

$$r_{act} = 3r_{earth}$$

$G = 6.67 * 10^{-11}\ N \cdot m^2/kg^2$
$m_e = 6.0 * 10^{24}\ kg$
$r_e = 6.4 * 10^6\ m$
} pg 239

$$F_G = \left(6.67*10^{-11}\frac{N \cdot m^2}{kg^2}\right)\frac{(60\,kg)(6.0*10^{24}\,kg)}{(3*6.4*10^6\,m)^2}$$

$$\boxed{F_G = 65\ N}$$

WATCH CALCULATOR WORK