

ACP PHYSICS MIDTERM REVIEW: KINEMATICS

1) $v_0 = +4 \text{ m/s}$
 $V = v_0 + at$

$$V = +36 \text{ m/s}$$

$$t = 4 \text{ s}$$

$$a = ?$$

$$\frac{v-v_0}{t} = a$$
$$\frac{(+36 \text{ m/s}) - (+4 \text{ m/s})}{4 \text{ s}} = a$$

$$\boxed{+8 \text{ m/s}^2} = a$$

2) $v_0 = +36 \text{ m/s}$

$$V = +15 \text{ m/s}$$

$$t = 3 \text{ s}$$

$$a = ?$$

$$V = v_0 + at$$
$$\frac{v-v_0}{t} = a$$
$$\frac{(+15 \text{ m/s}) - (+36 \text{ m/s})}{3 \text{ s}} = a$$

$$\boxed{-7 \text{ m/s}^2} = a$$

3) $v_0 = +2.0 \text{ m/s}$

$$a = -0.50 \text{ m/s}^2$$

(a) $t = 2 \text{ s}$ (b) $t = 5 \text{ s}$

$$V = ?$$

(a) $V = v_0 + at$

$$V = (+2.0 \text{ m/s}) + (-0.50 \text{ m/s}^2)(2 \text{ s})$$

$$\boxed{V = +1.0 \text{ m/s}}$$

(b) $V = v_0 + at$

$$V = (+2.0 \text{ m/s}) + (-0.50 \text{ m/s}^2)(5 \text{ s})$$

$$\boxed{V = -0.5 \text{ m/s}}$$

Rolling Down Hill Now

4) $v_0 = 0$

$$a = +5.5 \text{ m/s}^2$$

$$V = +28 \text{ m/s}$$

$$t = ?$$

$$V = v_0 + at$$
$$\frac{v-v_0}{a} = t$$

$$\frac{(+28 \text{ m/s}) - (0)}{+5.5 \text{ m/s}^2} = t$$

$$\boxed{5.09 \text{ s}} = t$$

5) $v_0 = +22 \text{ m/s}$

$$a = -2.1 \text{ m/s}^2$$

$$t = 9.0 \text{ s}$$

$$V = ?$$

$$V = v_0 + at$$
$$V = (+22 \text{ m/s}) + (-2.1 \text{ m/s}^2)(9.0 \text{ s})$$
$$\boxed{= +3.1 \text{ m/s}}$$

$$6) V_0 = \emptyset$$

$$V^2 = V_0^2 + 2ad$$

$$a = +3.5 \text{ m/s}^2$$

$$V = +25 \text{ m/s}$$

$$d = ?$$

$$\frac{(25 \text{ m/s})^2 - \emptyset^2}{2(+3.5 \text{ m/s}^2)} = d$$

$$\boxed{+89.3 \text{ m} = d}$$

$$7) V_0 = \emptyset$$

$$(a) V = V_0 + at$$

$$(b) d = V_0 t + \frac{1}{2} at^2$$

$$\begin{aligned} \uparrow & a = g = -9.8 \text{ m/s}^2 \\ \downarrow & t = 1.5 \text{ s} \end{aligned}$$

$$V = \emptyset + (-9.8 \text{ m/s}^2)(1.5 \text{ s})$$

$$d = \emptyset + \frac{1}{2}(-9.8 \text{ m/s}^2)(1.5 \text{ s})^2$$

$$\boxed{V = -14.7 \text{ m/s}} \\ \text{(Down)}$$

$$\boxed{d = -11.0 \text{ m}} \\ \text{(Down)}$$

$$(a) V = ?$$

$$(b) d = ?$$

$$8) V_0 = \emptyset$$

$$d = V_0 t + \frac{1}{2} at^2$$

$$d = \emptyset + \frac{1}{2}(-9.8 \text{ m/s}^2)(6.5 \text{ s})^2$$

Rock Fell 207 m Down,
So Cliff Must Be 207 m
TALL.

$$a = g = -9.8 \text{ m/s}^2$$

$$t = 6.5 \text{ s}$$

$$d = ?$$

$$= -207 \text{ m}$$

$$9) \xrightarrow{\leftarrow +}$$

$$V_x = +900 \text{ m/s}$$

$$X = ?$$

$$t = ?$$

$$\downarrow -$$

$$V_0 = \emptyset$$

$$V = ?$$

$$a = -9.8 \text{ m/s}^2$$

$$y = -1.2 \text{ m}$$

$$t = ?$$

STEP 1: Use Vertical Info To Find t :

$$y = \cancel{V_0 t} + \frac{1}{2} at^2$$

$$\sqrt{\frac{2y}{a}} = t$$

$$0.495 \text{ s} = t$$

STEP 2: Use Horizontal Info To Find x :

$$x = V_x \cdot t$$

$$= (+900 \text{ m/s})(0.495 \text{ s})$$

$$\boxed{= +446 \text{ m}}$$

$$10) \begin{array}{c} \leftarrow + \\ \rightarrow + \end{array}$$

$$V_x = +11.4 \text{ m/s}$$

$$V_0 = \emptyset$$

$$x =$$

$$a = -9.8 \text{ m/s}^2$$

$$y = 15.5 \text{ m}$$

$$t =$$

STEP 1: FIND VERTICAL VELOCITY OF GOLF BALL JUST BEFORE IT HITS THE WATER.

$$v^2 = v_0^2 + 2ay$$

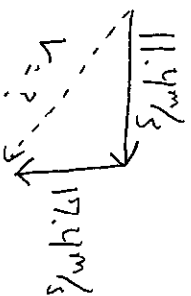
$$v = \pm \sqrt{v_0^2 + 2ay}$$

$$v = \pm \sqrt{\emptyset + 2(-9.8 \text{ m/s}^2)(15.5 \text{ m})}$$

$$= \pm 17.4 \text{ m/s}$$

Ball is moving down, so $v = -17.4 \text{ m/s}$

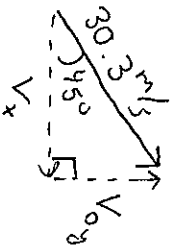
STEP 2: COMBINE HORIZONTAL + VERTICAL VELOCITIES.



$$v = \sqrt{(11.4 \text{ m/s})^2 + (17.4 \text{ m/s})^2}$$

$$v = 20.8 \text{ m/s}$$

11) STEP 1: COMPONENTS OF INITIAL VELOCITY.



$$V_x = (30.3 \text{ m/s}) \cos 45^\circ = 21.4 \text{ m/s}$$

$$V_{0y} = (30.3 \text{ m/s}) \sin 45^\circ = 21.4 \text{ m/s}$$

$$(a) \begin{array}{c} \leftarrow + \\ \rightarrow + \end{array}$$

$$V_x = +21.4 \text{ m/s}$$

$$x =$$

$$t =$$

$$\begin{array}{c} \leftarrow + \\ \rightarrow + \end{array}$$

$$V_{0y} = +21.4 \text{ m/s}$$

$$v =$$

$$a = -9.8 \text{ m/s}^2$$

$$t = ?$$

$$y = \emptyset \text{ (since it returns to starting height)}$$

$$y = v_0 t + \frac{1}{2} a t^2$$

$$\emptyset = 21.4 t - 4.9 t^2$$

$$\emptyset = t(21.4 - 4.9 t)$$

$$t = \{ \emptyset, 4.37 \text{ s} \}$$

THERE ARE 2 MOMENTS WHEN THE BALL IS ON THE GROUND... AT $t = \emptyset$ (BEFORE LAUNCH) AND 4.37 s LATER

ALTERNATE SOLUTION: FIND TIME TO PEAK (WHERE $v_y = \emptyset$) AND DOUBLE IT.

$$v_0 = +21.4 \text{ m/s}$$

$$v = \emptyset$$

$$a = -9.8 \text{ m/s}^2$$

$$v = v_0 + at$$

$$\frac{v - v_0}{a} = t$$

$$\text{TOTAL TIME} = 2.18 \text{ s} \times 2$$

$$= 4.37 \text{ s}$$

(b) HORIZONTAL

$$V_x = +21.4 \text{ m/s}$$

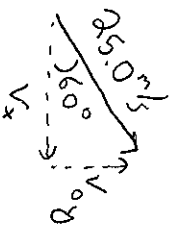
$$t = 4.37 \text{ s}$$

$$x = ?$$

$$x = V_x t$$

$$= +93.5 \text{ m}$$

(a) STEP 1: COMPONENTS OF INITIAL VELOCITY.



$$v_{0y} = (25.0 \text{ m/s}) \sin 60^\circ = 21.7 \text{ m/s}$$

$$v_x = (25.0 \text{ m/s}) \cos 60^\circ = 12.5 \text{ m/s}$$

VERTICAL INFO: \downarrow

$$v_0 = +21.7 \text{ m/s}$$

$$v = 0 \text{ (AT PEAK)}$$

$$a = -9.8 \text{ m/s}^2$$

$$t = ?$$

TIME TO PEAK:

$$v = v_0 + at$$

$$2.21 \text{ s} = t$$

TOTAL HANG TIME = TIME TO PEAK $\times 2$

$$y =$$

$$\text{TOTAL TIME} = 4.43 \text{ s}$$

13) BALL A

$$v_x = +20 \text{ m/s}$$

$$(b) x = ?$$

$$y = -15 \text{ m}$$

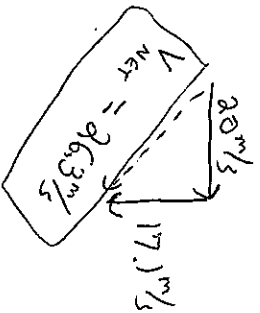
$$(a) y = v_0 t + \frac{1}{2} a t^2$$

$$1.75 \text{ s} = t$$

$$(b) x = v_x \cdot t = 35.0 \text{ m}$$

$$(c) v_y^2 = v_{0y}^2 + 2ay$$

$$v_y = -17.1 \text{ m/s}$$



BALL B

$$v_x = +17.3 \text{ m/s}$$

$$(b) x = ?$$

$$y = -15 \text{ m}$$

$$(a) y = v_0 t + \frac{1}{2} a t^2 \quad \text{OR - FIND } v_y \text{ FIRST (} v_y^2 = v_{0y}^2 + 2ay \text{)}$$

USE QUAD FORMULA

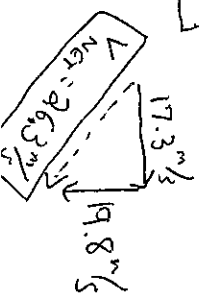
THEN t

$$t = 3.05 \text{ s}$$

$$(b) x = v_x \cdot t = 52.08 \text{ m}$$

$$(c) v_y^2 = v_{0y}^2 + 2ay$$

$$v_y = -19.8 \text{ m/s}$$



Equations:

$$\sum F_y = 0 \dots \therefore F_N = mg$$

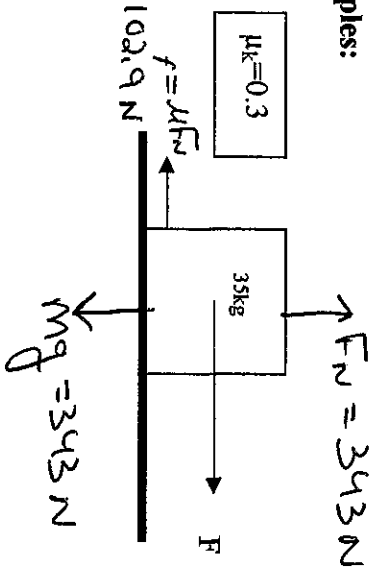
$$\sum \vec{F} = m\vec{a}$$

$$W = mg$$

$$F_{\text{KINETIC}} = \mu_k F_N$$

$$F_{\text{STATIC}} \leq \mu_s F_N$$

Examples:

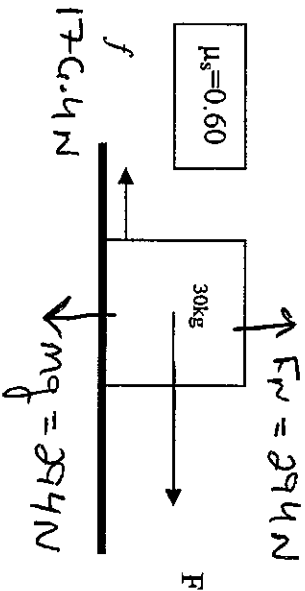


Find F if the object is moving with an acceleration of 4 m/s^2

$$\sum F = ma$$

$$F - 102.9 \text{ N} = 35 \text{ kg} (4 \text{ m/s}^2)$$

$$F = 37.1 \text{ N}$$



Find F if the object is on the "verge of slipping".

$$\sum F = 0$$

$$F - 176.4 \text{ N} = 0$$

$$F = 176.4 \text{ N}$$

Q1) Does surface area change the amount of friction? (Explain)

$$F = \mu F_N \quad (\text{NO})$$

Q2) What is the advantage of antilock brakes? (Why is not locking to your advantage?)

Tire REMAINS in static friction static > kinetic

Q3) If the Earth exerts 1500N of force on a satellite, how much force does the satellite exert on the earth?

Third Law $F_{S,E} = 1500 \text{ N}$ then $F_{E,S} = 1500 \text{ N}$

Q4) Your mass is 80kg. You stand on a scale in an elevator as it accelerates downward at -2 m/s^2 .

- Draw the F.B.F.D.
- What is the value of the Net Force (F_{net})?
- What is the direction of the Net Force?
- What is your weight (F_g)?
- What is the value of the Normal Force (F_N)?

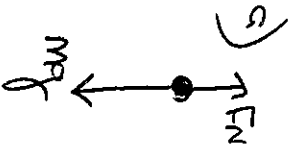
$$\sum F_y = ma$$

$$e) F_N - Mg = ma$$

$$F_N = ma + mg$$

$$F_N = 80 \text{ kg} (-2 \text{ m/s}^2) + 80 \text{ kg} (9.8 \text{ m/s}^2)$$

$$F_N = 624 \text{ N}$$



$$b) F_{\text{net}} = ma$$

$$F_{\text{net}} = (80 \text{ kg})(-2 \text{ m/s}^2)$$

$$F_{\text{net}} = -160 \text{ N}$$

c) down

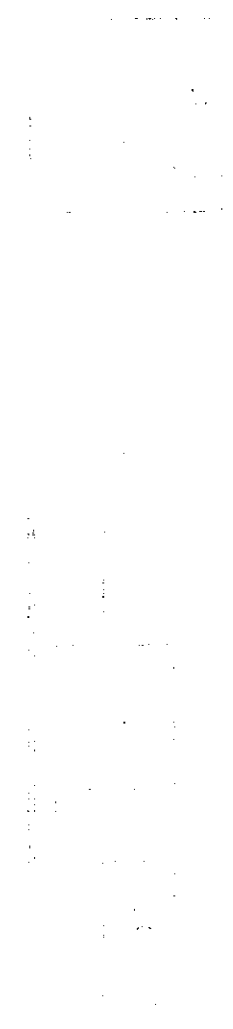
$$d) \text{Weight} = mg = 784 \text{ N}$$

The following table shows the results of the experiment. The first column shows the number of trials, the second column shows the number of correct responses, and the third column shows the percentage of correct responses. The data shows that the number of correct responses increases as the number of trials increases, and that the percentage of correct responses is consistently high, around 80%.

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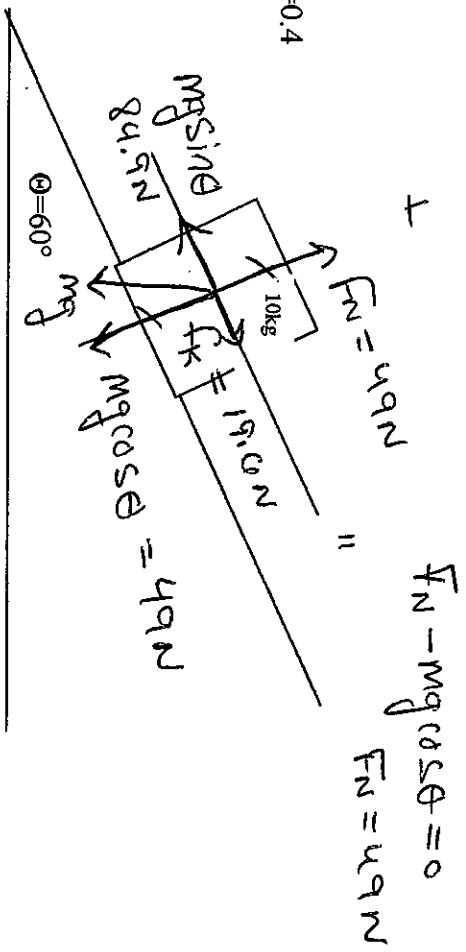
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Find the rate of acceleration down the plane.

$$\mu_k = 0.4$$



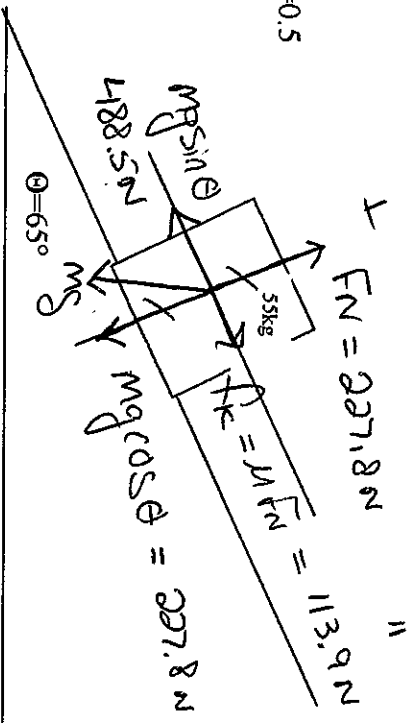
$$\sum F_{\parallel} = ma$$

$$(84.9\text{N} - 19.0\text{N}) = 10\text{kg}(a)$$

$$a = 6.53\text{m/s}^2$$

Find the rate of acceleration down the plane.

$$\mu_k = 0.5$$



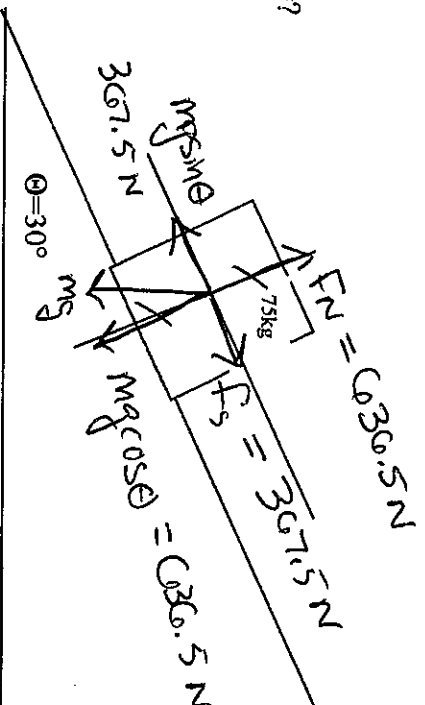
$$\sum F_{\parallel} = ma$$

$$[488.5\text{N} - 113.9\text{N}] = 55\text{kg}(a)$$

$$a = 6.8\text{m/s}^2$$

Find the value that will keep the object at rest on the plane.

$$\mu_s = ?$$



$$\sum F_{\parallel} = 0$$

$$367.5\text{N} - f_s = 0$$

$$f_s = 367.5\text{N}$$

$$367.5\text{N} = \mu_s F_N$$

$$\mu_s = \frac{367.5\text{N}}{636.5\text{N}} = .58$$

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Distinguish whether a mass is experiencing a net push/pull or no net push/pull in the following circumstances. Ignore the effect of air resistance unless otherwise stated.

Circumstance	Possible Push/Pull	Definite Push/Pull	Definite Net Push/Pull	No Net Push/Pull	Name the Forces
A mass is rising, after being tossed-up.		✓	✓		F_g
A mass is resting on a book, which is sliding with constant velocity across a frictionless surface.				✓	F_g, F_N, F_r, F_t
A mass is moving with constant velocity through a gravity-free region of space.				✓	?
A mass on the end of a string is whirled around in a circle. R_c			✓		F_T
A mass accelerates down an inclined plane.			✓		F_N, F_g, F_r, F_t
A mass is at rest on a table, which is on the Moon.				✓	F_N, F_g
A mass accelerates down an inclined plane, which is on the Moon.			✓		F_N, F_g, F_r, F_t
A mass is "moving" through water, toward the bottom of a pool.	No way to know				?
A mass is "descending" through water, toward the bottom of a pool. d	NO way to know				F_g, F_b, F_o
A mass is falling straight down from an airplane with terminal velocity. (Air resistance is significant)				✓	F_g, F_o

Weight = F_g

Sliding Friction = F_r

Normal Force = F_N

Tension = F_T

Drag force (Air, water or any fluid resistance) = F_D

1. The first part of the document is a list of names and titles.

2. The second part of the document is a list of dates and times.

3. The third part of the document is a list of locations and addresses.

4. The fourth part of the document is a list of events and activities.

5. The fifth part of the document is a list of organizations and institutions.

6. The sixth part of the document is a list of individuals and their roles.

7. The seventh part of the document is a list of financial records and transactions.

8. The eighth part of the document is a list of legal documents and contracts.

9. The ninth part of the document is a list of technical specifications and standards.

10. The tenth part of the document is a list of miscellaneous information and notes.

Item	Date	Location	Event	Organization	Individual	Financial	Legal	Technical	Miscellaneous
1	1998-01-15	New York	Meeting	ABC Corp	John Doe	\$1000	Contract	Spec A	Note 1
2	1998-02-20	Los Angeles	Conference	XYZ Inc	Jane Smith	\$2000	Agreement	Spec B	Note 2
3	1998-03-10	Chicago	Workshop	DEF Ltd	Bob Johnson	\$500	Deed	Spec C	Note 3
4	1998-04-05	San Francisco	Seminar	GHI Corp	Alice Brown	\$3000	Warranty	Spec D	Note 4
5	1998-05-18	London	Exhibition	JKL Group	Charlie White	\$1500	License	Spec E	Note 5
6	1998-06-22	Paris	Convention	MNO Corp	Diana Green	\$4000	Patent	Spec F	Note 6
7	1998-07-12	Madrid	Forum	PQR Inc	Frank Black	\$2500	Trademark	Spec G	Note 7
8	1998-08-08	Amsterdam	Workshop	RST Ltd	Grace King	\$1800	Copyright	Spec H	Note 8
9	1998-09-15	Stockholm	Meeting	UVW Corp	Henry Lee	\$3500	Patent	Spec I	Note 9
10	1998-10-20	Oslo	Conference	XYZ Inc	Ivy Chen	\$2200	Trademark	Spec J	Note 10

11. The eleventh part of the document is a list of contact information and phone numbers.

12. The twelfth part of the document is a list of references and sources.

13. The thirteenth part of the document is a list of appendices and additional documents.

ACP. PHYSICS MIDTERM REVIEW: UCM

$$1) v = \frac{2\pi r}{T} \rightarrow T = \frac{2\pi r}{v} = \frac{2\pi(8850\text{m})}{110\text{m/s}} = \boxed{163\text{ s}}$$

$$2) v = \frac{2\pi r}{T} = \frac{2\pi(2600\text{m})}{360\text{s}} = 45.4\text{m/s}$$

$$a_c = \frac{v^2}{r} = \boxed{0.792\text{m/s}^2}$$

$$3) a_c = \frac{v^2}{r} = \frac{(8.8\text{m/s})^2}{25\text{m}} = \boxed{3.10\text{m/s}^2}$$

$$4) 45 \frac{\text{rev}}{\text{min}} \rightarrow \frac{1\text{min}}{45\text{rev}} \times \frac{60\text{s}}{1\text{min}} = 1.33 \frac{\text{s}}{\text{rev}} = T$$

$$(a) v = \frac{2\pi r}{T} = \frac{2\pi(0.05\text{m})}{1.33\text{s}} = 0.236\text{m/s}$$

$$a_c = \frac{v^2}{r} = \frac{(0.236\text{m/s})^2}{0.05\text{m}} = \boxed{1.11\text{m/s}^2}$$

$$(b) v = 0.471\text{m/s} \quad a_c = \boxed{2.22\text{m/s}^2}$$

$$(c) v = 0.707\text{m/s} \quad a_c = \boxed{3.33\text{m/s}^2}$$

$$5) v = \frac{2\pi r}{T} = 7.90\text{m/s}$$

$$(a) F_c = m \frac{v^2}{r} = \boxed{7.48\text{N}}$$

$$(b) \text{Doubling } v \text{ Quadruples } F_c! \quad \boxed{F_c = 29.9\text{N}}$$

$$6) v = \frac{2\pi r}{T} = 8.17\text{m/s}$$

$$(a) a_c = \frac{v^2}{r} = \boxed{51.3\text{m/s}^2}$$

$$(b) F_T \text{ IS THE NET CENTRIFUGAL FORCE} \quad F_T = F_c = m a_c$$

$$= \boxed{359\text{N}}$$

$$7) v = \frac{2\pi r}{T} = 4.95 \text{ m/s}$$

TENSION IS THE NET CENTRIFUGAL FORCE: $F_c = m \frac{v^2}{r} = \boxed{0.343 \text{ N}}$

$$8) (a) F_g = \frac{G m_1 m_2}{r^2} = \frac{(6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2)(363 \text{ kg})(517 \text{ kg})}{(0.5 \text{ m})^2} = \boxed{5.01 \times 10^{-5} \text{ N}}$$

$$(b) F_g = \frac{(6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2)(363 \text{ kg})(154 \text{ kg})}{(0.75 \text{ m})^2} = \boxed{6.63 \times 10^{-6} \text{ N}}$$

$$(c) F_g = \frac{(6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2)(517 \text{ kg})(154 \text{ kg})}{(0.25 \text{ m})^2} = \boxed{8.50 \times 10^{-5} \text{ N}}$$

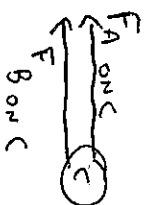
$$(d) \Sigma F_{\text{ON A}} = 5.67 \times 10^{-5} \text{ N TO THE RIGHT}$$



$$\Sigma F_{\text{ON B}} = 3.49 \times 10^{-5} \text{ N TO THE RIGHT}$$



$$\Sigma F_{\text{ON C}} = 9.16 \times 10^{-5} \text{ N TO THE LEFT}$$



$$9) F_{\text{Sun on Earth}} = \frac{(6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2)(2.00 \times 10^{30} \text{ kg})(5.98 \times 10^{24} \text{ kg})}{(1.50 \times 10^8 \text{ m})^2} = \boxed{3.55 \times 10^{22} \text{ N}}$$

$$F_{\text{Moon on Earth}} = \frac{(6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2)(7.35 \times 10^{22} \text{ kg})(5.98 \times 10^{24} \text{ kg})}{(3.85 \times 10^8 \text{ m})^2} = \boxed{1.98 \times 10^{20} \text{ N}}$$

$$F_{\text{Sun on Earth}} \approx 100 \times F_{\text{Moon on Earth}}$$

ACP PHYSICS MIDTERM REVIEW

ENERGY PROBLEMS

1) a) $K = \frac{1}{2}mv^2 = \frac{1}{2} \cdot 1000\text{kg} \cdot (20)^2 = \underline{200,000\text{J}}$

b) $w = F \cdot d = 500\text{N} \cdot 10\text{m} = \underline{5000\text{J}}$

c) $w = \Delta K = \underline{5000\text{J}}$

d) THERMAL ENERGY DUE TO FRICTION

2) $P_{PE} = mgh = 2\text{kg} \cdot 10\frac{\text{N}}{\text{kg}} \cdot 20\text{m} = \frac{1}{2} \cdot 2\text{kg} \cdot v^2$
 $\downarrow 20\text{m}$
 $\downarrow \Delta PE = 0$
 $\downarrow KE = \frac{1}{2}mv^2$
 $v = \sqrt{2gh}$
 $= \sqrt{400} = \underline{20\frac{\text{m}}{\text{s}}}$

3) $P = \frac{w}{t} = \frac{F \cdot d}{t} = \frac{mgh}{t}$
 $= \frac{60\text{kg} \cdot 10\frac{\text{N}}{\text{kg}} \cdot 3\text{m}}{4\text{s}} = \boxed{450\text{WATTS}}$
 $\frac{450\text{W}}{747\text{W/HP}} = \boxed{0.6\text{HP}}$

4) $P_{IE} = mgh = 90\text{kg} \cdot 10\frac{\text{N}}{\text{kg}} \cdot 3.2\text{m} = \boxed{2880\text{J}}$
 $h = 8\text{STEPS} \cdot 0.4\text{m/STEP} = 3.2\text{m}$

5) $\text{WORK} = \Delta KE$
 $F \cdot d = \frac{1}{2}mv^2 \Rightarrow d = \frac{mv^2}{2F} = \frac{82\text{kg} (4.2\frac{\text{m}}{\text{s}})^2}{2 \cdot 140\text{N}} = \boxed{15.2\text{m}}$

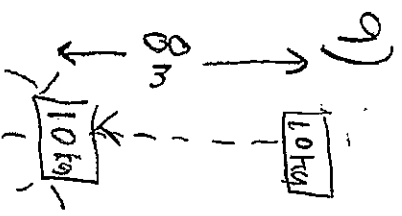
6) $F \cdot d = \frac{1}{2}mv^2 \Rightarrow F = \frac{mv^2}{2d} = \frac{1.8 \times 10^6\text{kg} (14\text{m/s})^2}{2 \cdot 1500\text{m}} = \boxed{1.18 \times 10^5\text{N}}$

7) $\text{SPRING PE} = \text{GRAVITATIONAL PE}$
 $F_{\text{AV}} \cdot d = mgh \Rightarrow h = \frac{F_{\text{AV}} \cdot d}{mg} = \frac{5\text{N} \cdot 0.8\text{m}}{0.02\text{kg} \cdot 10} = \boxed{20\text{m}}$

8) $P = \frac{w}{t}$
 $w = \Delta KE = \frac{1}{2}(1000\text{kg} (40\frac{\text{m}}{\text{s}})^2 - 0) = 8 \times 10^5$
 $\frac{8 \times 10^5\text{J}}{4\text{s}} = 2 \times 10^5\text{W} = \boxed{200\text{KW}}$

ACP PHYSICS MIDTERM REVIEW

ENERGY PROBLEMS (CONT'D)

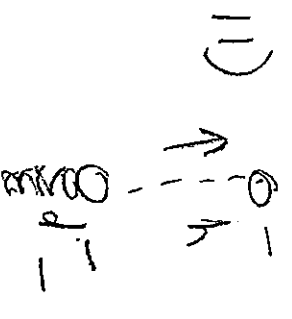
9) 

$$800J = \frac{1}{2}(100) v^2$$

$$\frac{800J}{5 \text{ kg}} = v^2 = 160 \frac{\text{m}^2}{\text{s}^2}$$

$$v = \boxed{12.8 \text{ m/s}}$$

10) $w = F \cdot d = 10,000 \text{ kg} \times 10 \frac{\text{N}}{\text{kg}} \times 1500 \text{ m} = \boxed{15 \times 10^8 \text{ J}}$

11) 

$$F_{av} \cdot d = mgh$$

$$h = \frac{F_{av} \cdot d}{mg} = \frac{2.8 \text{ N} \cdot 15 \text{ m}}{0.10 \text{ kg} \times 10 \frac{\text{N}}{\text{kg}}} = \boxed{233 \text{ m}}$$

12) $\eta = \frac{\text{Power OUT}}{\text{Power IN}} = \frac{600 \text{ kg} \cdot 10 \frac{\text{N}}{\text{kg}} \cdot 3 \text{ m}}{600 \text{ W}} = \boxed{50\%}$

