11thPhysics(2018-19) 2ndQ Quiz-1

	Total	K+E	I+O
Student	36	19	17
Average	24.9/50	26.8/50	22.8/50
Best	43.5/50	43.5/50	39.0/50

11th Physics (2018 – 19)

(2ndQ, #1Mini Test)

Class	No.	Name Solutions

In calculation problems, describe equations clearly and systematically enough to show how to solve the problems. If not enough, you won't get any points.

The circular constant	$\pi = 3.14159...$
Conversion from atmosphere to pascal	$1.000\ atm = 1.013 \times 10^5\ Pa$
Gravitational acceleration rate	$g = 9.80\ m/s^2$
Universal Gravitational Constant	$G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$
The radius of the Earth	$R_E = 6{,}370\ km$
Mass of the Earth	$M_E = 5.97 \times 10^{24}\ kg$

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4 pt/question x 13 questions = 52 pt Max 50 pt

/[Total 50 pt]

Keio Academy of New York 11/29/2018 By Tohei Moritani

(1) An airplane lands and begins to slow down as it moves along the runway. If its mass is 3.45 x 10^5 kg and the net braking force is 4.35 x 10^5 N, what is the airplane's acceleration?
(Equations)

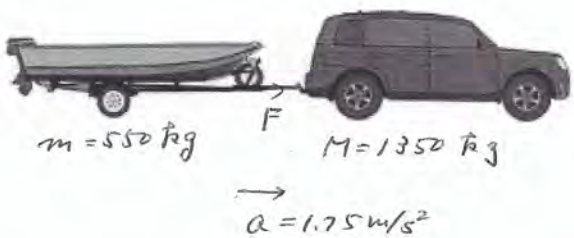
$m = 3.45 \times 10^5$ kg

$f = 4.35 \times 10^5$ N

$a = \frac{f}{m} = \frac{4.35 \times 10^5}{3.45 \times 10^5} = 1.26$ m/s²

(1) Answer: 1.26 m/s² backward (87%)

(2,3) Your 1350-kg car pulls a 550-kg boat-trailer away a stoplight with an acceleration of 1.75 m/s².
(2-a) What is the net force exerted by your car on the boat-trailer?
(2-b) What force does the trailer exert on your car?
(3) What is the net force acting on your car?
Equations



(2-a) $F = ma$

$= 550 \times 1.75 = 962.50 \longrightarrow 962$

(2-b)

(3) $\sum F = Ma$

$= 1350 \times 1.75$

$= 2362.50$

$\longrightarrow 2360$ (N)

(2-a) Answer: 962 N forward (48%)

(2-b) Answer: 962 N backward

960 N OK

(3) Answer: 2360 N forward (42%).

2400 N forward OK

(4,5) As part of a physics experiment, you place a 2.63-kg watermelon on a scale inside an elevator. When the elevator is moving, you read the scale as 3.14 kg.
(4) Find the direction and magnitude of the acceleration of the elevator.
(5) In the above problem, the elevator is moving downward from 8th floor toward ground floor. Is the elevator speeding up or slowing down?

Equations

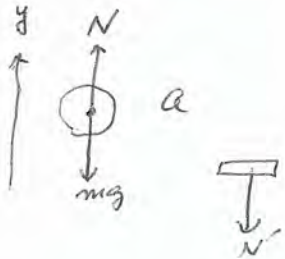
$N - mg = ma$

$N = N' = 3.14 \times 9.80$

$a = \dfrac{N - mg}{m}$

$= \dfrac{3.14 \times 9.80}{2.63} - 9.80$

$= 1.900 \longrightarrow 1.90 \ (m/s^2)$



(4) Answer
1.90 m/s² upward (54%)

(5) Answer
slowing down (64%)

(6) Figure 1 at the right shows a measurement of the coefficient of friction between a 2.4- kg block and a board: the block is connected to a scale with string and the board is drew leftward. The block begins to slide when the scale shows 9.5 N. The scale shows 7.5 N when the board is continued to move.
(6-a) What are the coefficient of static friction, μ_s, and the friction of kinetic friction, μ_k?
(6-b) Using the block and the board, the board is inclined as shown in Figure 2. Predict the angle where the block begins to slide.
(Equations)

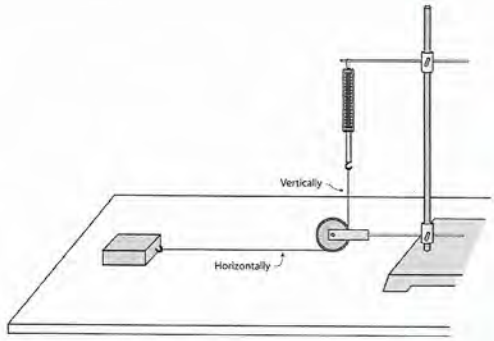


Figure 1

(a) $F_s = \mu_s N = \mu_s mg$

$$\mu_s = \frac{F_s}{mg} = \frac{9.5}{2.4 \times 9.80}$$

$$= 0.404 \longrightarrow 0.40$$

$F_k = \mu_k N = \mu_k mg$

$$\mu_k = \frac{F_k}{mg} = \frac{7.5}{2.4 \times 9.80}$$

$$= 0.319 \longrightarrow 0.32$$

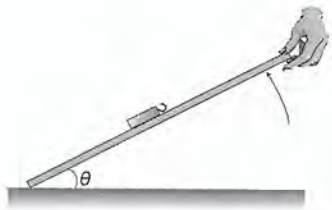


Figure 2

(b) $\tan\theta_c = 0.404$

$\theta_c = \tan^{-1} 0.404$

$= 22.0^\circ$

$\longrightarrow 22^\circ$

(6-a) Answer

μ_s 0.40

μ_k 0.32

(64 %)

(6-b) Answer

22°

(7) A 66-kg sprinter wishes to accelerate from rest to a speed of 16 m/s in a distance of 14 m. What coefficient of static friction is required between the sprinter's shoes and the track?
(Equations)

$$v_f^2 - v_i^2 = 2ax$$

$$a = \frac{v_f^2 - v_i^2}{2x}$$

$$= \frac{16^2 - 0}{2 \times 14}$$

$$= 9.14$$

$$F \leqq F_{max} = \mu_s N = \mu_s m g$$

$$\mu_s \geqq \frac{F}{mg} = \frac{ma}{mg} = \frac{a}{g}$$

$$= \frac{9.14}{9.80} = 0.933$$

$$\rightarrow 0.93$$

(7) Answer

0.93 or more than 0.93

(66%)

-0.5 without "more than"

(8,9) A light rope is passed over a light and frictionless pulley, and a 20.5 kg stand is connected to the one end of the rope, as shown in the figure. A 62.0 kg person rides on the stand and pulls the other end of the rope.

(8-a) Draw a free-body diagram for the person and explain the forces.

(8-b) Draw a free-body diagram for the stand and explain the forces.

(9) Find the magnitude of the force, exerted by the person, enough to lift off the ground.

(Equations)

$W = mg$

$N = N'$, $W' = Mg$

$N + T = W$

$+)\quad T = W' + N'$

$2T = (m+M)g$

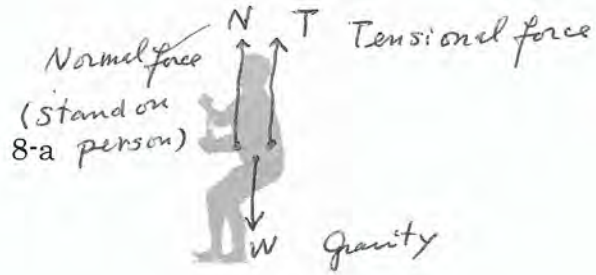
$F = T$

$= \frac{1}{2}(m+M)g$

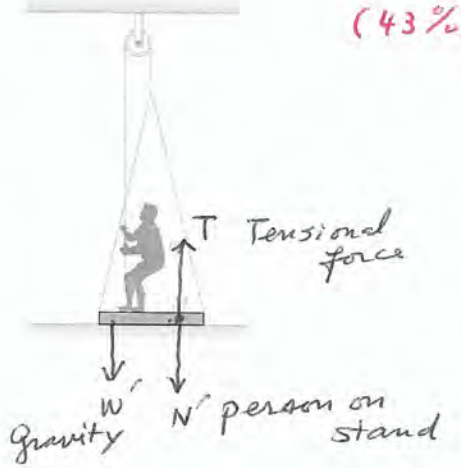
$= \frac{1}{2}(62.0+20.5)\times 9.80$

$= 404.25 \longrightarrow 404$

8-a



8-b



(43%)

(9) Answer

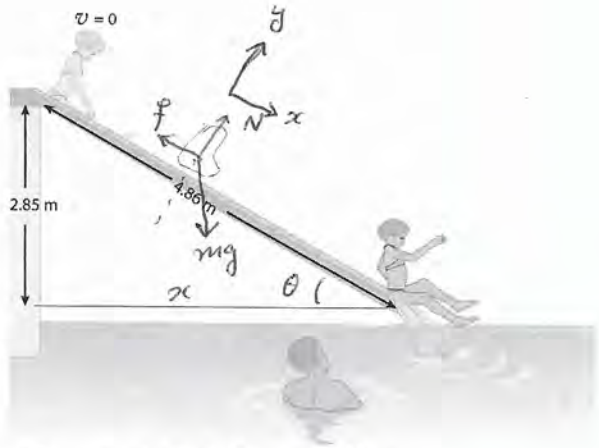
404 N

(0%)

(10, 11) A 51.6-kg girl slides from rest with constant acceleration down a 4.86-m-long ramp into a pool of water. The top of the ramp is 2.85 m high from the water surface and the coefficient of kinetic friction between the girl and the ramp is 0.210.

(10) Find the acceleration rate of the girl.

(11) Find the speed of the girl when she reaches the water.



(10) $\sum \vec{F} = m\vec{a}$

$\vec{N} + \vec{f} + m\vec{g} = m\vec{a}$

$N_x + f_x + (mg)_x = ma_x \longrightarrow 0 - f + mg\sin\theta = ma_x$

$N_y + f_y + (mg)_y = ma_y \longrightarrow N - 0 - mg\cos\theta = ma_y = 0$

$N = mg\cos\theta$

$f = \mu_k N$

$= mg\mu_k \cos\theta$

$ma_x = mg\sin\theta - mg\mu_k\cos\theta$

$x = \sqrt{4.86^2 - 2.85^2} = 3.937$

$\sin\theta = \frac{2.85}{4.86} = 0.5864$

$\cos\theta = \frac{3.937}{4.86} = 0.8100$

$a_x = 9.80(0.5864 - 0.210 \times 0.8100)$

$= 4.080 \longrightarrow 4.08$

(11) $v_f^2 - v_i^2 = 2ax$

$v_f = \sqrt{2ax}$

$= \sqrt{2 \times 4.080 \times 4.86}$

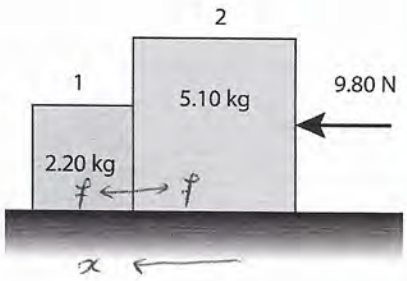
$= 6.297$

$\longrightarrow 6.30$

(10) Answer: 4.08 m/s² downward (32%)

(11) Answer: 6.30 m/s (25%)

(12) A box of mass 2.20 kg rests on a smooth, horizontal floor next to a box of mass 5.10 kg. You push on the 5.10 kg box with a horizontal force of magnitude 9.80 N.
(12-a) What is the acceleration of the boxes?
(12-b) What is the force of contact between the boxes?



(a) whole system $a = \frac{F}{m}$

$= \frac{9.80}{2.20+5.10} = 1.342 \rightarrow 1.34$

(b) #1 Box

$f = m_1 a$

$= 2.20 \times 1.342$

$= 2.953$

$\rightarrow 2.95$

(12-a) Answer 1.34 m/s² to left
(12-b) Answer 2.95 N

(80%)

2.96 N 8割

(13) Internal Space Station (ISS) is a habitable satellite. The radius of the orbit is 350 km above the Earth surface. Find the gravitational acceleration rate (g') at the orbit.

The radius of the Earth $R_E = 6{,}370$ km

The mass of the Earth $M_E = 5.97 \times 10^{24}$ kg

$$F = G\frac{M}{r^2}m = mg$$

$$g = \frac{GM_E}{(R_E + 350\,km)^2}$$

$$= \frac{5.97\times10^{24} \times 6.67\times10^{-11}}{(6.370\times10^{6} + 0.350\times10^{6})^2}$$

$$= \frac{5.97\times10^{24} \times 6.67\times10^{-11}}{(6.720\times10^{6})^2}$$

$$= 0.1322 \times 10^{1}$$

$$= 0.8818 \times 10^{1}$$

$$= 8.818 \longrightarrow 8.82$$

(13) Answer

$8.82\ m/s^2$ (18%)