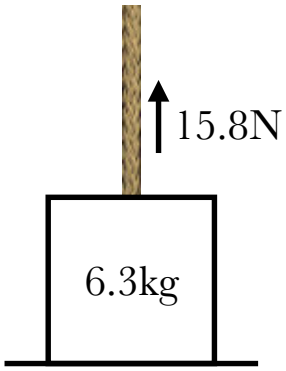
Physics 2130 Sample Exam 1 Solutions
2026

1. A 6.3 kg block sits on a table. A rope attached to the top of it exerts an upward force of 15.8 N on the box.



4 (a) **C** What is the weight W of the block?

A) 0.64 N **B)** 6.3 N **C)** 62 N

$W = mg = (6.3\,\text{kg})(9.8\,\text{N/kg}) = 62\,\text{N}$

4 (b) **B** What is the normal force of the table on the block?

A) 15.8 N **B)** 45.9 N **C)** 61.7 N **D)** 77.8 N

The normal force points upward, and the forces must balance:

$$0 = 15.8\uparrow + N\uparrow + 62\,\text{N}\downarrow \implies N = 45.9\,\text{N}$$

4 2. **B** Which of the following statements is impossible (i.e. never true)?

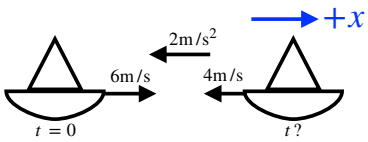
A) "Ignoring air resistance, a ball thrown across the room is in free-fall."
B) "A car drives around a circle with constant velocity."
C) "A falling object has positive velocity."

A car driving in a circle changes direction, so it can't have a constant velocity.

4 3. **C** A ball is thrown into the air. At the top of its flight, the acceleration of the ball

A) points up **B)** is zero **C)** points down

4. A sailboat starts off at time $t = 0$ moving 6 m/s to the right, but a wind blows on the sailboat, giving it an acceleration of $2\,\text{m/s}^2$ to the left, eventually making the boat turn around. At time t, the boat is moving at 4 m/s to the left.



4 (a) Fill in the table with what is given.

Δx	DKDC
v_i	+6m/s
v_f	−4m/s
a	-2m/s^2
Δt	NEED

4 (b) What is the value of Δt?

We choose the equation that doesn't include Δx:

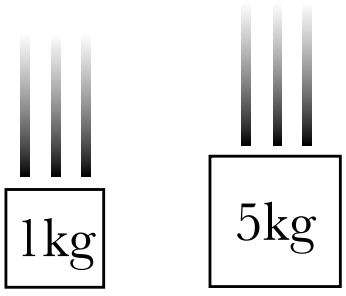
$$v_f = v_i + a\Delta t$$

$$-4 = +6 - 2\Delta t$$

$$-10 = -2\Delta t$$

$$\Longrightarrow \Delta t = \boxed{5\,\text{s}}$$

5. Two masses, 1 kg and 5 kg, are dropped from the same height. Ignore air resistance.



2 (a) B Which block feels a greater net force?

A) The 1 kg block **B)** The 5 kg block
C) Both feel the same nonzero force.
D) Both feel zero force.

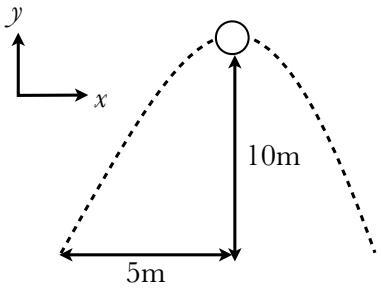
2 (b) C Which block has the larger acceleration?

A) The 1 kg block **B)** The 5 kg block
C) Both have the same acceleration.

2 (c) C Which block will hit the ground first?

A) The 1 kg block **B)** The 5 kg block
C) Both will hit at the same time.

6. A ball is fired into the air. It reaches the top of its arc 10 m above the ground and 5 m along the ground. Suppose I want to know how fast the ball is moving at the top of the arc.



4 (a) Fill in everything that is known about the problem.

Δx	5m	Δy	10m
v_{ix}		v_{iy}	
v_{fx}	NEED	v_{fy}	0m/s
a_x	0 m/s^2	a_y	-9.8 m/s^2
Δt	NEED		

4 (b) D What is the first equation you would use to solve this equation?

A) $v_{fx}^2 = v_{ix}^2 + 2a\Delta x$

B) $\Delta y = \frac{1}{2}(v_{iy} + v_{fy})\Delta t$

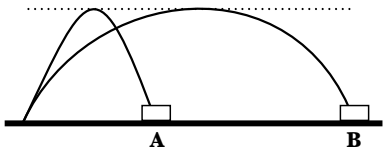
C) $v_{fx} = v_{ix} + a_x\Delta t$

D) $\Delta y = v_{fy}\Delta t - \frac{1}{2}a_y(\Delta t)^2$

E) $\Delta x = v_{ix}\Delta t + \frac{1}{2}a_x(\Delta t)^2$

4 7. C Two cannonballs are fired from different cannons at the same time. They both reach the same height, and hit different targets. Which target is hit first?

A) A **B)** B **C)** Both at the same time

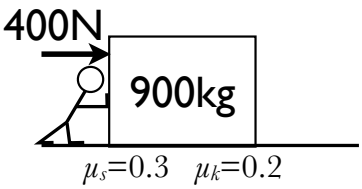


Look at the vertical motion: both start at the same height, go to the same height, and return to the same height. This will take the same amount of time for both cannonballs.

4

8. **B** A car is driving down the road at a constant 20 mph. The *net force* on the car
A) points forward **B)** is zero **C)** points backward

9. A person pushes horizontally on a 900 kg block with a force of 400 N. The block does not move. The coefficients of friction between box and floor are $\mu_s = 0.3$ and $\mu_k = 0.2$.



4 (a) **C** What is the force of static friction on the block from the floor?
A) 180 N **B)** 270 N **C)** 400 N **D)** 1800 N **E)** 2600 N

1 point credit for E

4 (b) **E** How hard would the person have to push to make the block move?
A) 180 N **B)** 270 N **C)** 400 N **D)** 1800 N **E)** 2600 N

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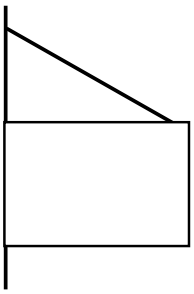
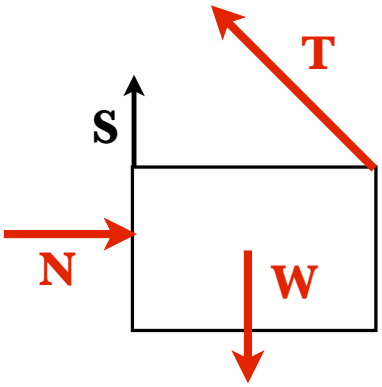
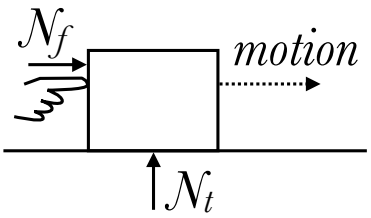
10. A sign is pressed against a wall, attached by a rope. Find all the forces acting on the sign, and draw and label them on the rectangle below. Use the labels W, N, K, S, and/or T. I've given you one: the wall exerts an upward static frictional force on the sign.





11. A block is being pushed across the table by a finger, which exerts a normal force of $N_f = 8\,\text{N}$ on the block. (The block's speed is not necessarily constant!) The table exerts a normal force upward of $N_t = 12\,\text{N}$ on the block. Kinetic friction also acts on the block, with a coefficient of kinetic friction $\mu_K = 0.5$.



4 (a) C What is the force of kinetic friction on the block?

A) 0.5 N **B)** 4 N **C)** 6 N **D)** 8 N **E)** 24 N

(I gave 2 points for B: you used the wrong normal force!) So the horizontal forces on the block are $N_f = 8 \rightarrow$ and $6 \leftarrow$. The rightward force is in the direction of motion, so...

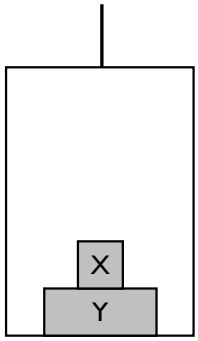
4 (b) A This block is

A) speeding up **B)** slowing down
C) maintaining a constant speed

4

12. **A** Two blocks are stacked on the floor of an elevator. According to Newton's Third Law, Which of the following *must* have the same magnitude as the force of the floor on block Y?

A) The force of block Y on the floor
B) The tension in the rope
C) The weight of block Y
D) The weight of both blocks
E) The force of block X on block Y



13. A block with mass 5 kg and weight 49 N is sliding down a frictionless hill with a $\theta = 50°$ slope.

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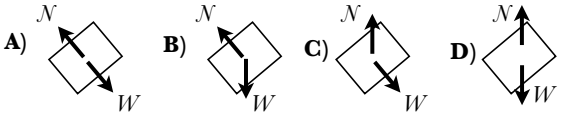
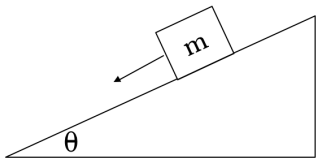
(a) **B** Which is the correct force diagram for the block?





	x	y
W	$mg\sin\theta$	$-mg\cos\theta$
N	0	N
$m\vec{a}$	ma	0

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(b) **C** Find the acceleration of the block.

A) $0\,\mathrm{m/s^2}$ **B)** $6.3\,\mathrm{m/s^2}$
C) $7.5\,\mathrm{m/s^2}$ **D)** $9.8\,\mathrm{m/s^2}$

Looking at the x column, we get $mg\sin\theta = ma \implies a = g\sin\theta$. In this case, $a = (9.8)\sin 50$

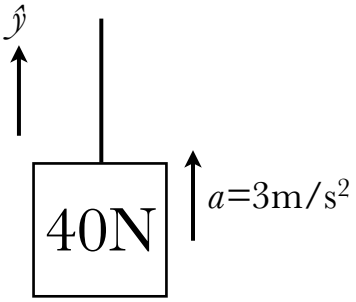
4

14. **C** A block with a mass of 4 kg and a weight of 40 N is being lowered on a string. The block's acceleration is $a = 3\,\mathrm{m/s^2}$ pointing upward. What is the tension in the rope?

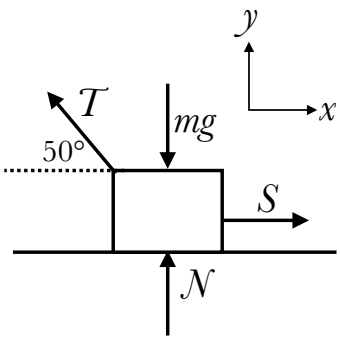
A) 28 N **B)** 40 N **C)** 52 N

The net force on the block is $+T - 40$, which is equal to $ma = 4(+3) = 12$. Thus

$$T - 40 = 12 \implies T = 52\,\mathrm{N}$$



15. The figure shows a stationary block of *weight* 90 N being pulled on by a rope which makes a 50° angle with the horizontal. The tension in the rope is 28 N.



4 (a) Fill in the table with what is given.

Box	x	y
Weight	0	-90N
Normal, table	0	N
Static Friction, table	S	0
Tension, rope	$-28\cos 50°$	$28\sin 50°$

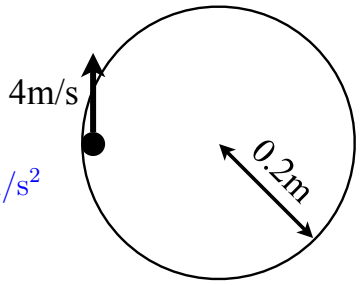
4 (b) Find the value of the static friction of the ground on the block.

This block is stationary, so the x column must add to zero. Thus

$$0 = S - 28\cos 50° \implies S = \boxed{18\text{ N}}$$

16. A marble spins around the inside of a glass with a radius of 0.2 cm. The marble spins with a constant speed of 4 m/s.

4 (a) Calculate the linear acceleration a of the marble.



$$a = \frac{v^2}{r} = \frac{(4\text{ m/s})^2}{0.2\text{ m}} = 80\text{ m/s}^2$$

4 (b) A What type of force is acting on the marble to cause its circular motion?

A) normal **B)** tension **C)** static friction **D)** none of these