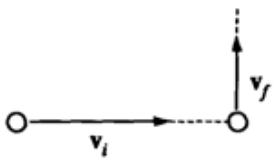
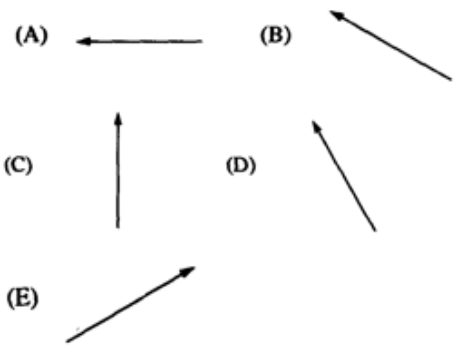
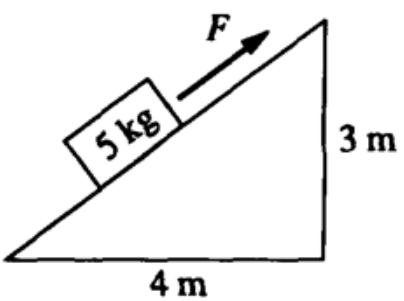
4. A particle of mass m moves along a straight path with a speed v defined by the function $v = bt^2 + c$, where b and c are constants and t is time. What is the magnitude F of the net force on the particle at time $t = t_1$?
(A) $bt_1^2 + c$ (B) $3mbt_1 + 2c$ (C) mbt_1 (D) $mbt_1 + c$ (E) $2mbt_1$



4. A ball initially moves horizontally with velocity v_i, as shown above. It is then struck by a stick. After leaving the stick, the ball moves vertically with a velocity v_f, which is smaller in magnitude than v_i. Which of the following vectors best represents the direction of the average force that the stick exerts on the ball?

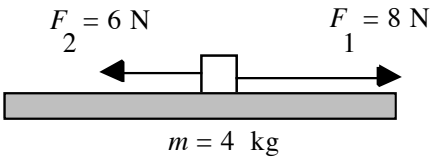




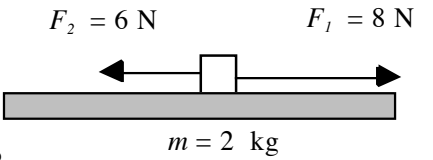
34. A block of mass 5 kilograms lies on an inclined plane, as shown above. The horizontal and vertical supports for the plane have lengths of 4 meters and 3 meters, respectively. The coefficient of friction between the plane and the block is 0.3. The magnitude of the force F necessary to pull the block up the plane with constant speed is most nearly
(A) 30 N (B) 42 N (C) 49 N (D) 50 N (E) 58 N

Forces on Objects on Smooth Surfaces—Velocity Change [32]

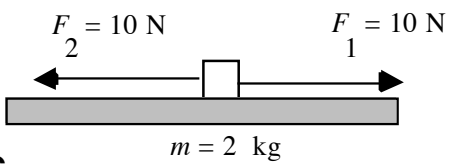
Two forces act on an object that is on a frictionless surface, as shown below. Rank these situations from greatest change in velocity to least change in velocity. (Note: All vectors directed to the right are positive, and those to the left are negative. Also, 0 m/s > -10 m/s.)



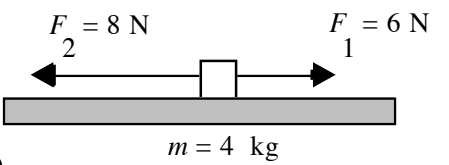
A



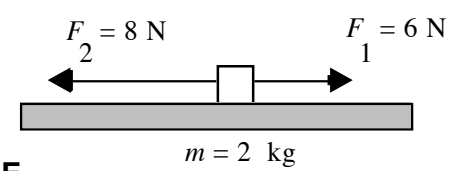
B



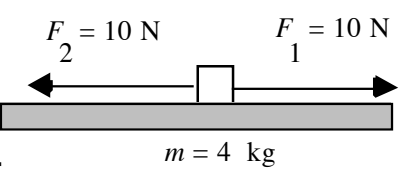
C



D



E



F

Greatest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Least

Or, the change in velocity is the same in all cases. _____

Or, the velocity will not change in any of these situations. _____

Please carefully explain your reasoning.

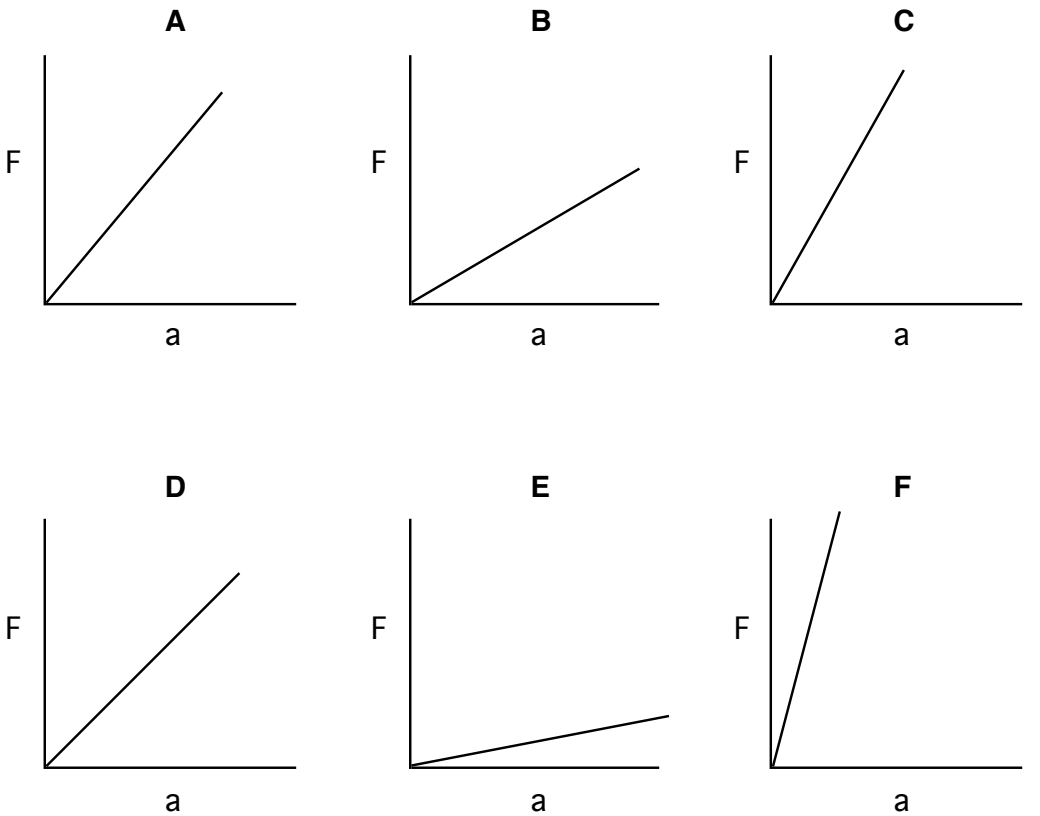
How sure were you of your ranking? (circle one)

Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[32] R. Krupp

Force Acceleration Graphs—Mass [24]

The following graphs plot force vs. acceleration for several objects. Rank each situation according to mass. That is, order the situations from the largest to the smallest mass that the force is acting upon. All graphs have the same scale for each respective axis.



Largest 1_____ 2_____ 3_____ 4_____ 5_____ 6_____ Smallest

Or, all the masses are the same. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

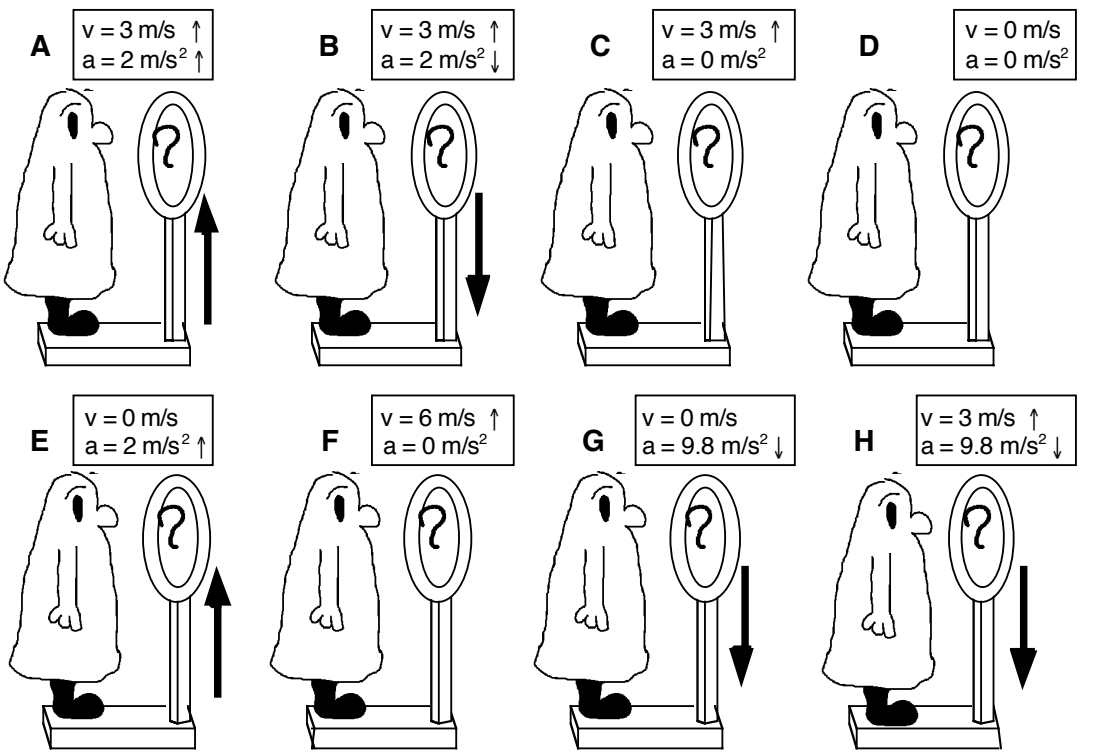
Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[24] D. Schramme, C. Fang, B. Speers

Person in an Elevator Moving Upward—Scale Weight [36]

The figures below depict situations where a person is standing on a scale in eight identical elevators. Each person weighs 600 N when the elevators are stationary. Each elevator now moves (accelerates) according to the specified arrow that is drawn next to it. In all cases where the elevator is moving, it is moving upward.

Rank the figures, from greatest to least, on the basis of the *scale weight* of each person as registered on each scale. (Use $g = 9.8$ m/s^2.)



Greatest 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ Least

Or, all of the scales read the same weight. _____

Or, all of the scales read zero weight. _____

Please carefully explain your reasoning.

How sure were you of your ranking? (circle one)

Basically Guessed				Sure					Very Sure
1	2	3	4	5	6	7	8	9	10

[36] O. Karmon

Hints Page

4. What is the quantity that connects the world of motion to the world of forces? How can you get that from v?

4. The velocity to the right has to be cancelled out and a velocity up has to be given.

34. You'd have to overcome the x-component of the weight and friction. (3-4-5 triangle!)

Ranking Task: Velocity Change: $\Sigma F=ma$

Ranking Task: Mass: $y=mx+b \rightarrow F=ma+0$

Ranking Task: Scale Weight: Scales read Normal Force! $N-mg=ma$ for each one. Velocity is a distractor.

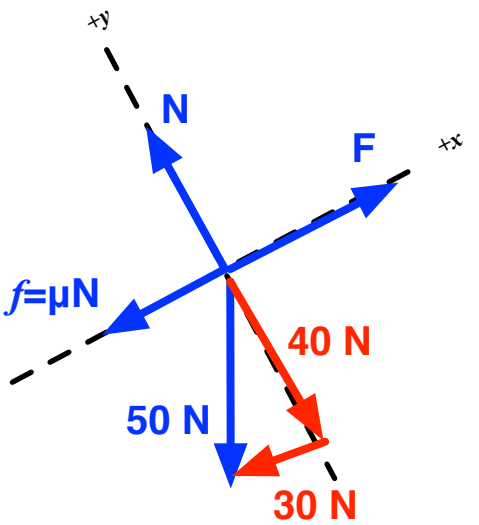
Answers Page

4. E

4. B

34. F - μN - 30 = 0
F - (0.3)(40) - 30 = 0
F - 12 - 30 = 0
F = 42 N

B



Ranking Task: Velocity Change:
greatest - B, A, [C, F], D, E - least

Ranking Task: Mass:
greatest - F, C, [A, D], B, E

Ranking Task:
greatest - [A, E], [C, D, E], B, [G, H]