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NAME _____ DATE _____

Scenario
Angela is in a stopped car at a traffic light when the light turns green and she accelerates.

Using Representations
PART A: Sketch and label vectors for velocity, acceleration, and net force on the car. (This is NOT a free-body diagram.)



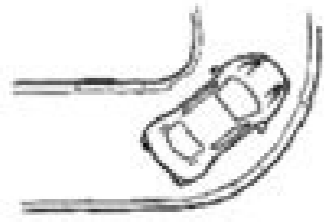
Which way does Angela's body "feel" pushed? Explain in a short sentence why she feels this way.
She feels pushed _____ because _____

PART B: As she approaches a stop sign, she slams on the brakes. Sketch and label vectors for velocity, acceleration, and net force on the car. (This is NOT a free-body diagram.)



Which way does Angela's body "feel" pushed?
Which way is the car accelerating?
Which direction is the net force on the car?

PART C: As Angela continues driving, she rounds a corner at a constant speed. Sketch and label vectors for velocity, acceleration, and net force on the car. (This is NOT a free-body diagram.)



Which way does Angela's body "feel" pushed?
Which way is the car accelerating?
Which direction is the net force on the car?

16. A car starts from rest and accelerates at 2.0 m/s^2 for 10.0 s .
a. How fast is the car moving?
b. How far has the car traveled?
c. How far has the car traveled in the first 5.0 s ?
d. How far has the car traveled in the last 5.0 s ?

17. A car starts from rest and accelerates at 2.0 m/s^2 for 10.0 s .
a. How fast is the car moving?
b. How far has the car traveled?
c. How far has the car traveled in the first 5.0 s ?
d. How far has the car traveled in the last 5.0 s ?

18. A car starts from rest and accelerates at 2.0 m/s^2 for 10.0 s .
a. How fast is the car moving?
b. How far has the car traveled?
c. How far has the car traveled in the first 5.0 s ?
d. How far has the car traveled in the last 5.0 s ?

19. A car starts from rest and accelerates at 2.0 m/s^2 for 10.0 s .
a. How fast is the car moving?
b. How far has the car traveled?
c. How far has the car traveled in the first 5.0 s ?
d. How far has the car traveled in the last 5.0 s ?

20. A car starts from rest and accelerates at 2.0 m/s^2 for 10.0 s .
a. How fast is the car moving?
b. How far has the car traveled?
c. How far has the car traveled in the first 5.0 s ?
d. How far has the car traveled in the last 5.0 s ?

Central Net Force Model Worksheet 4:
Orbital Motion

1. Suppose you are at mission control on the moon, in charge of launching a moon-orbiting communications satellite.

a. First, how much would a 1500 kg satellite weigh at the surface of the moon? (The gravitational field strength on Earth's moon is 1.6 m/s^2 , or 1.6 N/kg .)
 $F_g = mg$
 $(1.6 \text{ N/kg}) (1500 \text{ kg})$
 $F_g = 2400 \text{ N}$

b. The satellite is to have an altitude of 100 km above the moon's surface. What is the radius of the orbit of the satellite? (The radius of the moon is $1.74 \times 10^6 \text{ m}$.)

$r = 1.74 \times 10^6 \text{ m}$
 $h = 100 \text{ km}$
 $h = 100,000 \text{ m}$
 $r+h = 1.84 \times 10^6 \text{ m}$

c. Find the required orbital velocity for the satellite. (the moon's mass is 7.36×10^{22} kilograms)

mass moon $m = 7.36 \times 10^{22} \text{ kg}$
mass satellite $m = 1500 \text{ kg}$
 $G = 6.673 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$
 $v = \sqrt{\frac{GMm}{r}}$
 $v = \sqrt{\frac{(6.673 \times 10^{-11})(7.36 \times 10^{22})(1500)}{1.84 \times 10^6}}$
 $v = 1.634 \text{ m/s}$

d. How long will it take the satellite to orbit the moon? (This time is called the orbital period.)

$r = 1.84 \times 10^6 \text{ m}$
 $v = 1.634 \text{ m/s}$
 $C = 2\pi r$
 $C = 2\pi(1.84 \times 10^6) = 2.34 \times 10^7 \text{ m}$
 $t = \frac{C}{v} = \frac{2.34 \times 10^7}{1.634} = 1.43 \times 10^7 \text{ s}$
 $t = 1.9 \text{ hours}$

e. Is this satellite accelerating while in orbit? If so, what is the direction and magnitude of the acceleration?

yes, it is changing directions! It's going towards the center.
 $\frac{v^2}{r} = a$
 $\frac{(1.634)^2}{1.84 \times 10^6} = 1.45 \text{ m/s}^2$

2. The international space station orbits the earth at speed of approximately $17,000 \text{ mph}$ at a height of over 200 miles.

- Why do astronauts appear to "float" aboard the international space station?
- What sensation does an astronaut feel while in orbit?
- Are astronauts in orbit really "weightless"? What might be a better description?

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