Action & Reaction: Equal & Opposite

Name: _____

Physics 1

Period: _____

Forces and Interaction: Action-Reaction Pairs

In each case, draw a **free body diagram** of the object. For **every force** you draw, **identify the reaction** force.

1. A book sitting at rest on a table.

FBD	Action	Reaction

2. A girl pushing a book across a table.

FBD	Action	Reaction

3. An apple falling from a tree. Include air resistance.

FBD	Action	Reaction

4. A helicopter hovering stationary in the air.

FBD	Action	Reaction

5. A rocket flying through space.

FBD	Action	Reaction

6. An airplane flying in a straight line through the air.

FBD	Action	Reaction

Equal Force ≠ Equal Acceleration

7. A father (80 kg) and his young son (25 kg) are standing on ice. The son pushes his father backward with a force of 15 N. What will the father's acceleration be? What will the son's acceleration be?

F_{SF} = _____ , a_F = _____

F_{FS} = _____ , a_S = _____

8. A person firing a rifle (80 kg) fires a bullet (mass = 0.030 kg). The bullet is fired forward with an acceleration of 10,000 m/s^2. How much backwards acceleration does the person experience?

F_{PB} = _____ , a_B = _____

F_{BP} = _____ , a_P = _____

9. A person (70 kg) takes a step forward on an airplane (300,000 kg) with an acceleration of 3 m/s^2. How much backwards acceleration does the airplane experience as a result of the person stepping forward?

F_{AP} = _____ , a_P = _____

F_{PA} = _____ , a_A = _____

10. What if all 200 people on the airplane took a step forward at the same time? What would the resulting force and acceleration on the airplane be then?

F_{PA} = _____ , a_A = _____

11. A person (70 kg) jumps off of a building and falls with an acceleration of 9.8 m/s^2. How fast does the Earth (6×10^{24} kg) accelerate upwards towards him?

F_{EP} = _____ , a_P = _____

F_{PE} = _____ , a_E = _____

12. How far does the person fall towards the Earth in 1 second? How far does the Earth move towards the person in 1 second?

d_P = _____

d_E = _____

13. What if all 6 billion (6×10^9) people on Earth jumped of a building at the same time on the same side of the Earth. What would be the acceleration then?

F_{PA} = _____ , a_A = _____

14. How far would the Earth move in 1 second as a result of everyone jumping at once?

d_E = _____