1. a
2. e
3. d
4. e
5. c
6. a
7. a
8. e
9. d
10. c
11. b
12. 50 N

    The physics says that there has to be a force imbalance on your friend's car because it is not maintaining a constant velocity (i.e., it is accelerating). The value of the acceleration is 2.5 m/s divided by 60 s (remember to convert 1 min to 60 s when calculating the acceleration).

    In this case, the force imbalance is associated with the bumper force on the friend's car. The physics says that there are three forces acting on your friend's car: the normal force due to the ground, the gravitational force due to the Earth and the bumper force. In this case, the normal force and gravitational cancel each other out. We assume your friend's car is in neutral so the wheels move without friction. Consequently, there is no friction force on the car (there is a friction force on <u>your</u> car but we aren't looking at your car).

    From Newton's second law, the car's acceleration must equal the net force on the car divided by the car's mass. Your friend's car has an acceleration of 2.5 m/s divided by 60 s. The mass of that car is 1200 kg. Solving for the net force, I get 50 N. Since the force imbalance is due to the bumper force alone, that means the bumper force must be 50 N.

13. 0.18

    The physics says that there has to be NO force imbalance on the refrigerator because it is maintaining a constant velocity (i.e., it is not accelerating).

    The physics says that there are four forces acting on the refrigerator: the normal force due to the ground, the gravitational force due to the Earth, the applied force you are exerting and the friction force due to the floor. In this case, the normal force and gravitational cancel each other out. Likewise, your applied force and the friction force must cancel (remember that the object is not accelerating so the forces must balance). That means the friction force must be 350 N.

    The coefficient of friction is defined as the ratio of the friction and normal forces. We already know the friction force is 350 N. The normal force is whatever balances the gravitational force. The gravitational force is the mass (200 kg) times 9.8 N/kg. That gives 1960 N for both the gravitational force and the normal force. Take the ratio of the friction force and normal force to get the coefficient.

14. There is no single force you can exert on the refrigerator to make it do this, since the friction changes directions when the refrigerator changes directions. If you exert a force less than 350 N, the refrigerator will slow down. However, once stopped it will not automatically start moving the other way. You will have to move to the other side of the refrigerator and start pushing with a force greater than 350 N.