A-Level Physics - Newton's Laws of Motion - Solutions

1. (a) A body will remain at rest or keep travelling at constant velocity unless acted upon by a resultant external force.

(b)
(i) They have equal magnitude.
They are the same type of force.

(ii) They act in opposite directions.
They act on different objects/bodies.

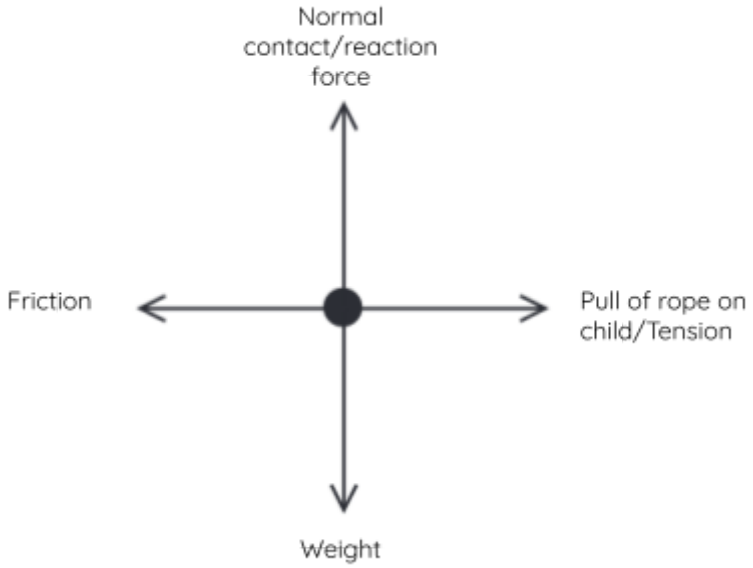
2. (a) As the carbon dioxide sublimates the solid CO_2 exerts a force on the CO_2 gas.
Using Newton's Third Law the gas will therefore exert a force on the solid CO_2.
Forces will be equal in magnitude and opposite in direction.
There is a resultant/unbalanced force in the solid CO_2.
Newton's First Law means the solid accelerates.
This acceleration will be rapid because the mass of the solid is small.
(b) There is more than one jet of gas.
Forces balance so no net resultant force in one direction.

3. (a) Newton's First Law states that an object will remain at rest or keep travelling at constant velocity unless acted upon by a resultant external force.
The friction between the floor and the passenger's feet causes the passenger to accelerate. (Could also say that the friction creates a resultant force on the feet).
The train accelerates but the man continues travelling at the original/constant speed
Or the top half of the passenger has no (resultant) force as the train accelerates
Or the man's speed relative to the train is lower
(b) Man pulls (backward) on the support
Due to Newton's Third Law the support exerts a (opposite) force on the man
This force is a resultant/unbalanced/net force on the man
Due to Newton's First and Second Laws the man will accelerate with the same acceleration/speed/velocity as the train

4. Newton's Third Law - every action has an equal but opposite reaction.

- Forces act on different bodies or forces act on the road and the tyre
- Forces act in opposite directions or (directions of the) forces are backwards and forwards
- Forces have same magnitude/size or both forces are 300 N
- Forces are of same kind or forces are both are (frictional) contact forces

5. (a)



(b)

- The rope is under tension
- Team A exerts a force on the rope and due to Newton's Third Law the rope exerts a force on Team A
- Force of rope on team A > frictional force for Team A
- Team A now has a resultant force (to the right)
- Team A accelerates (to the right) due to Newton's First and Second Laws
- The frictional force between Team B and the ground is larger
- Team B applies a greater force (on the rope) than team A