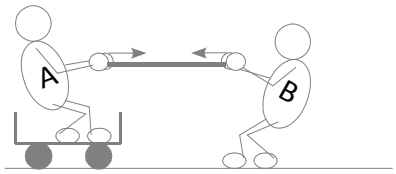
Practice: Force Arrows

Questions

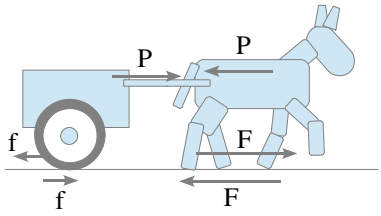
1.

(a) Draw any horizontal forces which are missing from the picture below.



(b) State whether or not person A accelerates.
(c) State whether or not person B accelerates.

2. In the diagram below, consider only forces that are shown.
Give your answers in terms of P, F and f.



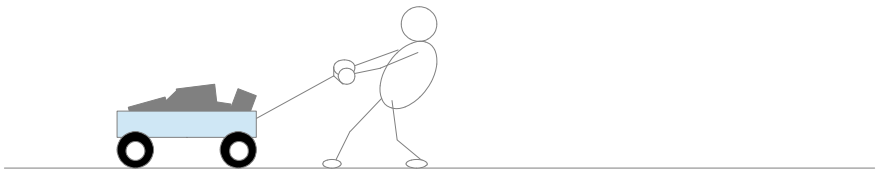
(a) State the forces exerted on the cart, and hence the net force on the cart.
(b) State the forces exerted on the robot horse, and hence the net force on the robot horse.
(c) State the forces exerted on the robot horse-cart system, and hence the net force on the system.
(d) To accelerate, the horse must push harder on the ground than it pulls on the cart. Explain why.

3.

(a) Draw a diagram of a mini colliding with a truck. Show the horizontal forces acting on them.
(b) List all the action-reaction pairs.
(c) Which vehicle feels more force?
(d) Which feels more acceleration?

4. A stick figure representation of a man pushes a stick representation of a large ball. Use a diagram showing the horizontal forces to explain how each will accelerate.

5. Josie is pulling a cart full of bricks, no doubt for some nefarious purpose. The cart full of bricks is heavier than Josie.
For this question, Josie remains stationary and the cart accelerates to the right.

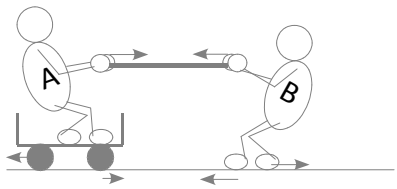


(a) Draw all the horizontal forces acting on the cart, the forces acting on Josie, and the forces acting on the ground. Ignore air friction. Make sure vectors (arrows) that should be the same length, *are* the same length.
(b) List all the action-reaction pairs.
(c) Explain why the cart accelerates but Josie doesn't.
(d) State the direction of the Earth's acceleration.
(e) If the cart and bricks have a mass of 112 kg, the force of friction with the ground is 50N and Josie is pulling with 428N, calculate the magnitude of the cart's acceleration.

Answers

1.

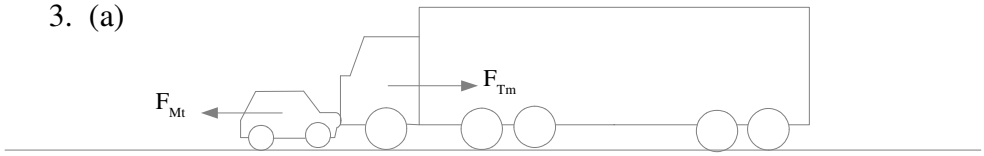
(a)



(b) Person A accelerates (his/her net force is not zero)
(c) Person B does not accelerate.

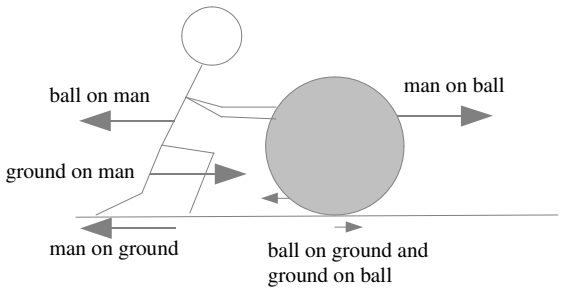
2. (a) P and f. The net force is P - f
(b) F and P. The net force is F - P
(c) F and f. The net force is F – f.
(d) So the net force on it will exceed zero.

3. (a)



(b) Truck pushes mini (F_{Mt}), mini pushes truck (F_{Tm})
(c) Neither, they feel the same
(d) The mini (it has less mass)

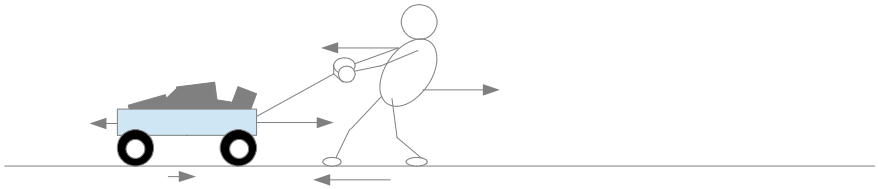
4.



The net force on the man is $\xrightarrow[\text{(by ground)}]{}$ and $\xleftarrow[\text{(by ball)}]{}$ so the net force on the man is zero; he does not accelerate.
The net force on the ball is $\xleftarrow[\text{(by ground)}]{}$ and $\xrightarrow[\text{(by man)}]{}$ so the net force is $\rightarrow$; the ball accelerates to the right.

5.

(a)



(b) Josie pushes ground, ground pushes Josie
Josie pulls cart, cart pulls Josie
Cart pushes (drags on) ground, ground pushes (drags on) cart

c) Forces on cart: $\leftarrow$ and $\rightarrow$ so net force $\rightarrow$ therefore accelerates right
Forces on Josie: $\leftarrow$ and $\rightarrow$ so net force 0 therefore no acceleration

d) Left

e) Net force is 428 – 50 = 378 N
Mass is 112 kg

$$a = \frac{F}{m} = \frac{378}{112} = 3.4 \text{ ms}^{-2} \quad (2 \text{ s.f.})$$