1) Snoopy (7.2 kg) is sitting on a box (11.8 kg) on a horizontal floor. The coefficient of friction between the box and the floor is 0.27 and there is no friction between Snoopy and the box. A horizontal force of 73 N to the right pushes on the box.

1.1) [6] Draw a free body diagram for Snoopy and for the box.

1.2) [2] Pick an appropriate set of coordinate axes.

1.3) [8] Apply Newton’s second law to each object in each direction. Include anything about the accelerations that you know without solving.

Snoppy x
\[ F_{bs} - m_s g = m_s a_{sx} \]

Snoppy y
\[ 0 = m_s a_{sy} \]

Box x
\[ 73 N - f = m_b a_{bx} \]
\[ + N - m_b g - F_{bs} = 0 \]
\[ N = m_b g + F_{bs} = m_b g + m_s g \]

Box y
\[ 0 = m_b a_{by} \]

1.4) [4] Find the acceleration (magnitude & direction) of each object while Snoopy sits on the box.

Snoopy x
\[ a_{sx} = \frac{0}{m_s} = 0 \]

Box x
\[ 73 N - \mu_k N = m_b a_{bx} \]
\[ m_b a_{bx} = 73 N - \mu_k (m_b + m_s) g \]
\[ + N - m_b g - F_{bs} = 0 \]
\[ N = m_b g + F_{bs} = m_b g + m_s g \]
\[ m_b + m_s \]
\[ a_{bx} = \frac{73 N - 50.3 N}{11.8 \text{ m/s}^2} = 1.93 \text{ m/s}^2 \]
2) An amusement park ride consists of a wide cylinder (radius=3.8 m). People stand inside with their back against the wall. The cylinder rotates (speed of wall=11 m/s) and then the floor is dropped away and friction holds the riders up. To increase the thrill, the ride can then be tilted by 25°.

2.1) [6] Draw a free body for the rider at the position shown.

2.2) [2] Pick an appropriate set of coordinate axes.

2.3) [8] Apply Newton's second law to the rider in each direction. Include anything about the accelerations that you know without solving.

\[ \sum F_x \quad N + mg \sin 25^\circ = ma_x = \frac{mv^2}{R} \]
\[ \sum F_y \quad f - mg \cos 25^\circ = ma_y = 0 \]

(using \[ \tan \theta = \frac{v_y}{v_x} \] then \[ a_x = \frac{v_x^2}{R} \cos 25^\circ \] and \[ a_y = -\frac{v_y^2}{R} \sin 25^\circ \]

2.4) [4] Find the normal force acting on the rider (mass=60kg).

\[ N = \frac{mv^2}{R} - mg \sin 25^\circ \]
\[ = \frac{(60 \text{kg})(11 \text{ m/s})^2}{3.8 \text{ m}} - (60 \text{ kg}) \times 9.8 \text{ m/s}^2 \times (\sin 25^\circ) \]
\[ = 1662 \text{ N} \]
1) \[
\frac{\Delta v}{\Delta t} = \frac{v - v_0}{t} = mg - T = ma
\]
\[
T = mg - ma = m(g - a) = (300 \, \text{kg}) (9.8 \, \text{m/s}^2 - 1.0 \, \text{m/s}^2) = 8800 \, \text{N} \quad \boxed{b}
\]

2) If he needs to push it to maintain a constant velocity, then there must be a friction force. Once he stops pushing, the total horizontal force will only be friction \boxed{c}

3) Newton's 3rd law: equal and opposite forces never act on the same object \boxed{c}

4) Maximum static friction is \( \mu_s N = \mu_s \, mg \) (only two vertical forces, no vertical acceleration) \( = (0.4)(500 \, \text{N}) = 200 \, \text{N} \). Friction can push back with a force of up to 200 N to prevent sliding. It only needs 170 N \boxed{c}

5) The vertical acceleration is zero, so the total force in the vertical direction is zero. \boxed{a}

6) \[
F = \frac{GM_{\text{planet}} M_{\text{object}}}{R^2}
\]
\[
\text{double mass of planet \rightarrow double force}
\]
\[
\text{double radius \rightarrow force cut by factor of 4}
\]
\[
(x2)^2 \quad \text{Force} \times 2 \times \frac{1}{4} = \frac{1}{2} \text{(original force)} \quad \boxed{a}
\]

7) Acceleration is to west. Friction is only horizontal force so friction is to west \boxed{d}