

Final Posting: Unit Test I — 2014/2015

Below you find:

- commentary to select questions (brief, not an attempt to re-teach the material),
- a brief outline of the solutions to the short answer problems (Questions 12 to 15), and
- the finalized answer key.

Shortly, you will find in your OWL Gradebook a new column called *UTI predictor*. This column will contain a prediction of your P1028A mark, based on performance on this Unit Test relative to the cohort of your peers, and after adjustments due to a differential between the Unit Test average and the anticipated course average. The Unit Test itself remains accessible in Test&Quizzes; however, the test is now also available as a pdf file in subfolder Unit Test I (located next to this file).

If you still struggle with the chapter content, or if you need feedback on how to improve your performance on multiple choice tests, please see me during my office hours.

(1) Commentaries:

Question 3:

The text states that the leg is at rest, but does not state that it is resting on something, since it isn't. In any multiple question you have to take the given information at face value, if I show you three forces, those you go by. The question is simply aiming at the contradiction between three forces on one side with only one having a horizontal component, and the reference "leg is held at rest" on the other side.

What I suggest the wise to carry away from this question is a basic principle of multiple choice tests: never assume anything when a peer could make with equal justification another assumption. Rather reflect on why you thought you needed that assumption and find another way to look at the question where such an assumption is not needed to answer. Recall William of Occam's statement discussed in class? It applies to everything we do – if you don't need an assumption, never make it.

Question 4:

Multiple choice questions are worded with no semantic width, they are to be taken at face value. If something is to be neglected, this will not be hinted through a veil, it will be the consequence of an unambiguous wording. Further, even if one force is much larger than another, you cannot automatically neglect the much smaller one, as it may act in a different direction.

Question 5:

Just because a figure comes from another chapter doesn't mean that you need for any conceivable question about the figure the concepts developed in that chapter. This is an example. The bottle is at rest. Further, there is the weight of the bottle and you know which way that force acts. The text then states to model the interaction between bottle and support by one additional force. For the bottle to be at rest, there is only one direction this force can go: straight up. And since Newton's laws have no exception, that is what is indeed correct.

Again, don't get lost in detail considerations where someone else could easily come up with alternative ideas. Anything you consider beyond the explicit text, ask yourself "must everyone else taking this test follow the same line of thought and make the same assumption and conjectures? If yes, continue, if no, you are wasting time musing around about things that cannot be necessary to arrive at an answer.

Question 6:

One may think that the bat doesn't fly parallel to the ground, which, however, must be accepted as the question text states "in level flight." When ever possible the wording of a multiple choice question will be as compressed as possible. During a Unit Test you can even google terms you are not sure about, but we suggest in general to have available (also in the Final Exam) an English Dictionary, such as the Merriam-Webster (available in the UWO bookstore). In aerodynamics, the lift force is always defined as

vertically upward (opposed to the weight), the horizontal forces are thrust and, opposite to it, air drag.

Question 7:

Note that we are explicitly clear in this question that you need not only to look at the figure, but also consult the text explaining in which direction things move in the figure, based on the actual parameter values. When you solve this problem (or read it in the textbook/solutions manual/course website), you find that in the given case both objects actually move toward the left, and that the object with mass m_2 moves up. Consider the suggested solution D which requires the angle θ_2 to increase (no particular angle is suggested). The incline at the right becomes more shallow, and a lesser fraction of the weight of object m_2 has to be balanced by the tension. So, the object pulls even less to its side than it does in the original case, and would therefore lose out to the other object pulling it up even more readily. Note that choices C and D are opposites, to see this helps pointing at either one of the two as the solution and therefore allows to narrow the choices down to these two.

Question 9:

Don't get sidetracked into thinking about possible external forces (where do you see any?) Or the relative masses of the objects. All of that cannot matter because we otherwise would have made a statement about it. The text simply restates Newton's third law which is always true. It is only concerned with the interaction forces between the two objects, and not affected by masses, motion, and other forces.

Question 11:

The lower arm and hand are one system in this case because this is explicitly stated in the question text. We have done this in class with other examples. Note that the examinations in this course are both reading material and lecture based, that is, exams may probe concepts that were exclusively discussed in class. No worry if you don't want to come to class or must leave early, you have two recordings of each class available to review what was discussed.

Question 15:

Someone suggested that the acceleration is zero in the reference system of the sleigh. This, however, is not an inertial reference system since it is accelerated. If you are interested in these issues, you may read further on Apparent Forces in Non-Inertial Reference Systems.

(2) Solutions to short answer problems

Question 12:

Three forces act on the system: the external force horizontally to the right, the weight vertically down and the tension to the upper left. You may choose any coordinate system, most convenient in this case is the x -axis to the right and the y -axis upwards.

This yields two formulas based on Newton's first law (because the object is at rest), the x -components of the net force include the magnitudes of the tension and the external force, and the y -components of the net force include the magnitudes of the tension and the weight.

Since both the magnitude of the tension, and the external force, are not known, you have to use both equations to eliminate the magnitude of the tension T , then solve for the magnitude of the external force.

Question 13:

We know both the direction (based on the angles in the free-body diagram) and the magnitude of the forces \mathbf{f} and \mathbf{F} . Note again: the magnitudes are NOT measured off the sketch or the free-body diagram, but are given in the text. The third force \mathbf{B} may have two components, one horizontal and one vertical component based on a choice of coordinate system with horizontal x - and vertical y -axis. Note that I provide this choice in the figure, so there is no ambiguity in that the positive x -axis points to the right.

You then write Newton's first law for the x - and y -components for the net force, each formula containing components of all three forces. You need only the x -component formula to solve for the x -component of the

force **B**. Note that the fact that this component will be negative can be anticipated from the figure and the given magnitudes of **f** and **F**.

Question 14:

The free-body diagram for the object on the incline includes three forces, tension to the upper left, normal force to the upper right, and weight straight down. The acceleration is also along the incline. Choosing the y-axis upwards in the direction along the incline, we find $T - W \cos\theta = m a$. Solve algebraically for m, you find $m = 1.05 \text{ kg}$.

Question 15:

While only the sleigh is pulled, both sleigh and object are combined as they move together. Newton's law horizontally for this system is $T = m a$, solve for a, $a = 1.43 \text{ m/s}^2$.

(3) Answer key

Q1 = C	Q2 = E	Q3 = C	Q4 = F	Q5 = C
Q6 = A	Q7 = C	Q8 = F	Q9 = D	Q10 = D
Q11 = H	Q12 = B	Q13 = A	Q14 = B	Q15 = B