Dr[redacted]

Expert TA was used in your PHYS[redacted] Course for the Fall 2013 semester. You had total of 23 assignments which contained a total of 218 problems. Of these, a total of 87 problems (39.9%) included at least one part that required the entry of a 'symbolic' (or 'algebraic') answer. The following table provides some key statistics associated with the work done by your students this semester that you may find interesting.

Consider the following while interpreting the data provided below. Assignments are made of problems, problems are made of parts (individual questions), and depending on your settings the students may be allowed multiple 'submissions' per part. For most assignments it appears that you allowed students up to 10 attempts for each question.

This semester the number of answers that students submitted, and that Expert TA graded, totaled 157590. Of these, 79748 answers were incorrect. When answers are incorrect there is often the opportunity to provide students with feedback. Expert TA had meaningful feedback for students 28604 times (or 35.9% of the time) for the overall course and 47.6 % of the time when incorrect answers for symbolic questions were submitted. Students chose to access available feedback 53.2% of the time overall and 57.9% of the time for symbolic questions.

Across all question types, students eventually reached the correct answer 72.1% of the time. (Note this may take the student more than one submission.) When students chose to access feedback, they arrived at the correct answer 90.6% of the time. (This also would include students using more than one submission.) This appears to be an indication that the feedback provided to students was helpful.

The following pages contain examples from your class to show how Expert TA is grading symbolic question types. The examples should demonstrate that our system is robust at accepting symbolic answers regardless of the form and also shows examples of feedback provided to students.

Fall 2013 Statistics		
Total Assignments	23.0	
Total Problems	218.0	
Total problems involving symbolic	87.0	
% of problems involving symbolic	40%	
Submission Statistics	**Overall**	**Symbolic**
total answers submitted and graded	157590	51114
average attempts required to reach correct answer	1.78	2.06
% of time answer is correct on first attempt	62.2%	54.1%
Total number of incorrect submissions	79748	30478
% of time meaningful feedback is available	35.9%	47.6%
% of time that students accessed feedback	53.2%	57.9%
% of time correct answer is eventually reached (regardless of whether feedback was accessed)	72.1%	70.4%
% of time correct answer is eventually reached (when feedback was accessed)	90.6%	85.3%

Hw 1 Full Credit – Problem 4, part d – [redacted]

Part (d) Considering the period of time from when the plane began to taxi and its takeoff, find a numeric value for the average acceleration in m/s^2.

Correct Answer	Student Answer	Final Grade
$a_{avg} = 0.229$	$a_{avg} = 0.23$	96%

Grade Detail

Correct	Student	Feedback	
		Final Answer Credit	100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	a_{avg} = 0.22	1%	-Your answer needs to include the time of taxi. -Time must be in seconds.	0%		0%	1%
2	a_{avg} = 4.375	1%		0%	The answer provided was not correct. We have recognized the following, - Your answer appears to be the reciprocal of the correct answer.	2%	3%
3	a_{avg} = 0.23	0%		0%		0%	0%
Totals		2%		0%		2%	4%

Hw 2 Full Credit – Problem 1, part c - [redacted] (identification of a sign error within a 'complicated' term)

Part (c) Write an expression for the time, t, it will take the car to come to a stop after applying the brakes using only variables in the problem statement.

Correct Answer	Student Answer	Final Grade
$t = (v_m+v_c)/a_b$	$t = (v_c+v_m)/a_b$	94%

Grade Detail

Correct	Student	Feedback	
		Final Answer Credit	100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$t = (v_m-v_c)/a_b$	1%		0%	Given the numerator $v_m - v_c$: • You have a sign error in this term.	2%	3%
2	$t = (v_c-v_m)/a_b$	1%		0%	Given the numerator $v_c - v_m$: • You have a sign error in this term.	2%	3%
3	$t = (v_c+v_m)/a_b$	0%		0%		0%	0%
Totals		2%		0%		4%	6%

Hw 2 Full Credit – Problem 2, part i - [redacted]

Part (I) Express v_f in terms of v_i.

Correct Answer	Student Answer	Final Grade
$v_f = -v_i$	$v_f = -v_i$	94%

Grade Detail

Correct	Student	Feedback
		Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$v_f = v_i$-9.8(.815)	1%		0%	• It appears that there may be a sign error associated with at least one term in your expression. Your answer is very close and contains something recognizable for all correct terms. Unfortunately there are additional terms in your equation that are not necessary.	2%	3%
2	$v_f = v_i$	1%		0%	• It appears that there may be a sign error associated with at least one term in your expression.	2%	3%
3	$v_f = -v_i$	0%		0%		0%	0%
Totals		2%		0%		4%	6%

Hw 2 Full Credit – Problem 2, part c - [redacted]

Part (c) Write an expression for the maximum height, h, the ball reaches in terms of v_f, v_i, and a.

Correct Answer	Student Answer	Final Grade
$h = (v_f^2-v_i^2)/(2a)$	$h = (v_f^2-v_i^2)/(2a)$	91%

Grade Detail

Correct	Student	Feedback
		Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$h = v_i+a/v_f$	1%	-The required equation is one of the basic equation of the constant acceleration of motion. There are several equations that you can choose from. To select the right one think about what you know; Do you know the time it takes to go from the ground to the top?	0%		0%	1%
2	$h = v_i^2+2a/v_f^2$	1%	-Do you know the initial velocity? Do you know the velocity of the ball at the top?	0%		0%	1%
3	$h = v_f^2-v_i^2/2a$	1%		0%		0%	1%
4	$h = (v_f^2-v_i^2)/2a$	1%	-Do you know the acceleration? -Which equation contains the distance, plus only things that you know?	0%		0%	1%
5	$h = v_i^2/2a$	1%		0%		0%	1%
6	$h = 2/a$	1%		0%		0%	1%
7	$h = (-v_f^2+v_i^2)/(2a)$	1%		0%	Given the numerator $-v_f^2 + v_i^2$: • You have a sign error in this term.	2%	3%
8	$h = (v_f^2-$	0%		0%		0%	0%

Hw 6 Full Credit – Problem 9, part c - [redacted] (example of robust grading)

Part (c) Write a symbolic equation for the location of the center of mass of the three beads relative to the center bead.

Correct Answer	Student Answer	Final Grade
$x'_{cm} = (m_3d_3-m_1d_2)/(m_1+m_2+m_3)$	$x'_{cm} = (m_1d_1+m_2(d_1+d_2)+m_3(d_1+d_2+d_3))/(m_1+m_2+m_3)-(m_2(d_1+d_2)/m_2)$	100%

Grade Detail

Correct	Student	Feedback

Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$x'_{cm} = (m_1d_1+m_2(d_1+d_2)+m_3(d_1+d_2+d_3))/(m_1+m_2+m_3)-(m_2(d_1+d_2)/m_2)$	0%	-Where should you place the origin for this problem? If a mass is located at the origin how will that mass be involved in the calculation? -What is the position of each bead relative to this origin? Are all of the positions positive?	0%		0%	0%
Totals		0%		0%		0%	0%

Hw 10 Full Credit – Problem 1, part c - [redacted] (example of robust grading)

Part (c) Write an expression for the cue balls velocity after the collision v_{1f}.

Correct Answer	Student Answer	Final Grade
$v_{1f} = (m_1-m_2)v/(m_1+m_2)$	$v_{1f} = ((2vm_1)-\sqrt{((-2vm_1)^2-4(m_1+m_2)(m_1v^2-m_2v^2)}))/(2(m_1+m_2))$	100%

Grade Detail

Correct	Student	Feedback

Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$v_{1f} = ((2vm_1)-\sqrt{((-2vm_1)^2-4(m_1+m_2)(m_1v^2-m_2v^2)}))/(2(m_1+m_2))$	0%	0%		0%		0%
Totals		0%	0%		0%		0%

Hw 5 Full Credit – Problem 3, part b - [redacted]

Part (b) Write an expression for the sum of the forces acting on the box in the y-direction, ΣF_y, given that up is the positive y-direction. Your answer should be in terms of F_N, m, and g.

Correct Answer	Student Answer	Final Grade
$\Sigma F_y = F_N-mg$	$\Sigma F_y = F_N-mg$	96%

Grade Detail

Correct	Student	Feedback

Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$\Sigma F_y = mg$	1%	-Gravity acts downward. In which direction does the normal force act?	0%	**Note: Feedback provided here but not accessed during assignment.** • It appears that there may be a sign error associated with at least one term in your expression.	0%	1%
2	$\Sigma F_y = -mg$	1%		0%	Keep in mind that the weight will need to be balanced by something (i.e. the floor of the elevator). Please reference your FBD for all forces acting on the box.	2%	3%
3	$\Sigma F_y = F_N-mg$	0%		0%		0%	0%
Totals		2%		0%		2%	4%

Hw 8 Full Credit – Problem 6, part b - [redacted] (For this particular part there was more than one way to enter the correct answer with the variables provided. Additionally this illustrates our ability to recognize equations, and errors within them, even when entered in a different form)

Part (b) The ramp makes an angle θ with the ground, where $\theta = 30$ degrees. Write an expression for the magnitude of the friction force, f_r, between the ramp and the skateboarder.

Correct Answer	Student Answer	Final Grade
$f_r = -W_f\sin(\theta)/h_y$	$f_r = -(((1/2)(m_s)(v_f^2))-(m_s(g)(h_y)))/(h_y/\sin(\theta))$	96%

Grade Detail

Correct	Student	Feedback

Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$f_r = (((1/2)(m_s)(v_f^2))-(m_s(g)(h_y)))/(h_y/\sin(\theta))$	1%	-Use the ramp height and the angle between the ramp and horizontal to determine the length of the ramp. -How does the work due to friction relate to the distance traveled by the skateboarder and the friction force? -The angle between the displacement of the skateboarder and the force of friction is 180 degrees. Does this matter?	0%	Your answer contains a sign error.	2%	3%
2	$f_r = (((1/2)(m_s)(v_f^2))+(m_s(g)(h_y)))/(h_y/\sin(\theta))$	1%		0%		0%	1%
3	$f_r = -(((1/2)(m_s)(v_f^2))-(m_s(g)(h_y)))/(h_y/\sin(\theta))$	0%		0%		0%	0%

Hw 4 Full Credit – Problem 6, part b - [redacted]

Part (b) Input an expression for the magnitude of the car's acceleration in terms of the variables provided, the acceleration due to gravity and θ.

Correct Answer	Student Answer	Final Grade
$a = g\tan(\theta)$	$a = ((mg/\cos(\theta))(\sin(\theta)))/m$	99%

Grade Detail

Correct	Student	Feedback

Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$a = (g\sin(\theta))$	1%	-Remember the net force equals mass times acceleration. -The weight has to equal the y-component of tension. -The x-component of the tension is the net force. -How can you use your trigonometry to link the vertical and horizontal components of F_T?	0%	**Note: Feedback provided here but not accessed during assignment.** • Pay careful attention to trigonometric relationships and how they affect components of the terms in your expression.	0%	1%
2	$a = ((mg/\cos(\theta))(\sin(\theta)))/m$	0%		0%		0%	0%
Totals		1%		0%		0%	1%

Hw 5 Full Credit – Problem 1, part b - [redacted]

Part (b) Write an expression for the sum of forces in the x direction in terms of T_1, T_2, m, g, α, and β. Use the specified coordinate system.

Correct Answer	Student Answer	Final Grade
$\Sigma F_x = T_2\cos(\beta)-T_1\sin(\alpha)$	$\Sigma F_x = T_2\cos(\beta)-T_1\sin(\alpha)$	90%

Grade Detail

Correct	Student	Feedback

Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	ΣF_x = mgsin(β)+mgcos(α)	1%	-You need to break each force down into the components and consider only components in the x direction. As you break the components down by angle, be very careful to look where the angles are measured from. -Not all angles are measured from horizontal, which affects how sin() and cos() relate to the vertical and horizontal components. -The two tensions should be the only forces acting in the x-direction and the x components of these forces should balance.	0%		0%	1%
2	ΣF_x = mg-(mgcos(θ)+mgsin(α))	1%		0%		0%	1%
3	ΣF_x = -mg+T_1cos(α)+T_2sin(β)	1%		0%	• It appears you have confused two variables involved in this expression. • You have used the wrong angle, but the correct trigonometric function. • It appears that there may be a sign error associated with at least one term in your expression. Your answer is very close and	2%	3%
5	ΣF_x = mg-T_1cos(α)-T_2sin(β)	1%		0%	• It appears you have confused two variables involved in this expression. • You have used the wrong angle, but the correct trigonometric function. • It appears that there may be a sign error associated with at least one term in your expression. Your answer is very close and contains something recognizable for all correct terms. Unfortunately there are additional terms in your equation that are not necessary.	2%	3%
6	ΣF_x = mg-T_1sin(α)-T_2cos(β)	1%		0%	**Note: Feedback provided here but not accessed during assignment.** • It appears that there may be a sign error associated with at least one term in your expression. Your answer is very close and contains something recognizable for all correct terms. Unfortunately there are additional terms in your equation that are not necessary.	0%	1%
7	ΣF_x = T_2cos(β)-	0%		0%		0%	0%

Hw 5 Full Credit – Problem 7, part a - [redacted] (appropriate feedback on a numeric question that helped the student to correct his mistake)

Part (a) What angle, θ in degrees, does the plane make with respect to the horizontal?

Correct Answer	Student Answer	Final Grade
$\theta = 43.526$	$\theta = 43.525$ $\theta = 43.525$	99%

Grade Detail

Correct	Student	Feedback

Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$\theta =$ 34.55 $\theta =$ 34.55	1%		0%	**Note: Feedback provided here but not accessed during assignment.** You may have used the wrong trigonometric function. Pay careful attention to which sides of the triangle are specified in the problem.	0%	1%
2	$\theta =$ 43.525 $\theta =$ 43.525	0%		0%		0%	0%
Totals		1%		0%		0%	1%

Hw 5 Full Credit – Problem 8, part c - [redacted]

Part (c) The table is inclined at an angle, θ, relative to the horizontal in such that the pulley is at the highest point and the 10 kg is removed from m_1. Write an equation for the normal force, F_N, of the block.

Correct Answer	Student Answer	Final Grade
$F_N = m_1 g\cos(\theta)$	$F_N = m_1 g\cos(\theta)$	96%

Grade Detail

Correct	Student	Feedback

Final Answer Credit 100%

Submission Detail

	Answer		Hints		Feedback		Totals
1	$F_N =$ $m_1 g\sin(\theta)$	1%	-Draw a Free Body Diagram of mass m_1, and label all of the forces. For this block, allow the y-direction to be oriented normal to the table and the x-direction to be oriented along the table toward the pulley. -What is the sum of the forces along the y-direction? Is the block accelerating along this direction?	0%	• This is the component of the weight oriented along the table. The normal force supports the component perpendicular to the table. You have a trigonometric error.	2%	3%
2	$F_N = (m_1 - m_2)g\cos(\theta)$	1%		0%	**Note: Feedback provided here but not accessed during assignment.** Your answer is very close and contains something recognizable for all correct terms. Unfortunately there are additional terms in your equation that are not necessary.	0%	1%
3	$F_N =$ $m_1 g\cos(\theta)$	0%		0%		0%	0%
Totals		2%		0%		2%	4%