

New York State Physical Setting: Physics

A Review of the June 2007 Exam
WNYPTA, Buffalo, NY
May 7, 2008
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SUNY Buffalo State College
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Assessment Purposes

• Teachers
  – Measure knowledge
  – Measure gain in knowledge
  – Sorting (Grading)
• Students/Parents
  – Measure preparation (predict success)
• School District/State Education Department
  – Degree requirements (benchmarks)
• Others...

March 6, 2008
Western Section STANYS Conference

Curriculum Standards

- Frameworks
- Syllabi
- Guides
- Blueprints
- Benchmarks

Assessment/Evaluation System

- Objective tests
- Performance assessments
- Portfolios
- Teacher Observations
- Group Activities
- Program Evaluations

Instructional Program

- Instructional styles
- Print materials
- Equipment
- Facilities
- Technology
- Community

March 6, 2008
Western Section STANYS Conference
Types of Analysis

- Traditional
  - Difficulty (Facility)
  - Discrimination
  - Response pattern
- Item format
- Difficulties analyzed in the context of issues:
  - Student
  - Instructional (Teacher, School)
  - Testing

Use of Assessment Data

- Formative techniques
  - Whiteboards
  - Exit slips
  - Homework assignments
  - Teacher quizzes
- Program review - Summative
  - Statewide and regional exam summaries
  - Mid-term and final exam data

Assessment Concepts

- Difficulty – Percentage or proportion that are successful on an item
- Discrimination – How well does an item differentiate between students who understand the subject and those who do not?
- Validity – Does an item measure student understanding of the intended concept?
Concepts (Continued)

- Reliability – can the results be replicated?
  - Inter-rater
  - Test/Re-test
  - Internal Consistency
- Criterion referenced tests

Test Validity

- Difficulty (facility) level?
- Discrimination?
- Placement on exam?
- Visual distraction by nearby (graphic) item?
- Style of question?
- Flawed item?

Test Data – Discussion and Analysis

- Collecting Data
- Analysis
  - Difficulty
  - Response Pattern
Multiple Choice Data

<table>
<thead>
<tr>
<th>Item</th>
<th>Key Idea</th>
<th>Major Understanding</th>
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</thead>
<tbody>
<tr>
<td>43</td>
<td>4.1-Trans. of Energy</td>
<td>4.1c Potential energy is the energy an object possesses by virtue of its position or condition. . .</td>
</tr>
<tr>
<td>44</td>
<td>4.1-Trans. of Energy</td>
<td>4.1d Kinetic energy is the energy an object possesses by virtue of its motion.</td>
</tr>
<tr>
<td>45</td>
<td>4.1-Trans. of Energy</td>
<td>4.1e In an isolated mechanical system, the sum of the macroscopic kinetic and potential energies. . .</td>
</tr>
<tr>
<td>46</td>
<td>4.1-Trans. of Energy</td>
<td>4.1i Power is the time-rate at which work is done or energy is expended.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Difficulty</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>NR</th>
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<td>2450</td>
<td>18</td>
<td>12</td>
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</table>

Claim #1 - Equivalent Resistance

Students do not have a conceptual understanding of energy dissipation within a circuit.
Equivalent Resistance

20 A 4.50-volt personal stereo uses 1950 joules of electrical energy in one hour. What is the electrical resistance of the personal stereo?

(1) 433 Ω  (3) 37.4 Ω  
(2) 96.3 Ω  (4) 0.623 Ω

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<td>493</td>
<td>265</td>
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<td>636</td>
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</tbody>
</table>

Equivalent Resistance (Con’t)

A 3.0-ohm resistor, an unknown resistor, R, and two ammeters, A₁ and A₂, are connected as shown with a 12-volt source. Ammeter A₂ reads a current of 5.0 amperes.

58. Determine the equivalent resistance of the circuit. [1]

\[ D = 0.49 \]

59. Calculate the current measured by Ammeter A₁. (Show all work) [2]

\[ D = 0.80 \]

60. Calculate the resistance of unknown resistor, R. (Show all work) [2]

\[ D = 0.63 \]

Claim #2 - Newton’s Third Law

Students do not “see” action/reaction pairs.

Modified Benjamin Bloom:

\[ \text{knowing} \]

\[ \text{using} \]

\[ \text{integrating} \]
Newton’s Third Law

A horizontal force of 8.0 newtons is used to pull a 20.0 newton wooden box moving toward the right along a horizontal, wooden surface, as shown.

![Diagram showing a box with a force vector labeled F = 8.0 N.]  

61 Starting at point $P$ on the diagram in your answer booklet, use a metric ruler and a scale of 1.0 cm = 4.0 N to draw a vector representing the normal force acting on the box. Label the vector $F_N$. [1]

62 Calculate the magnitude of the frictional force acting on the box. [Show all work, including the equation and substitution with units.] [2]

63 Determine the magnitude of the net force acting on the box. [1]

64 Determine the mass of the box. [1]

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Newton’s Third Law

10 Earth’s mass is approximately 81 times the mass of the Moon. If Earth exerts a gravitational force of magnitude $F$ on the Moon, the magnitude of the gravitational force of the Moon on Earth is:

(1) $F$
(2) $F/81$
(3) $9F$
(4) $81F$

**Item Difficulty**

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Claim #3 - 2-D Motion

Student find it difficult to recognize the independence of the vertical and horizontal motions.
2-Dimensional Motion

A projectile is launched into the air with an initial speed of $v_i$ at a launch angle of $30^\circ$ above the horizontal. The projectile lands on the ground 2.0 seconds later.

55. On the diagram in your answer booklet, sketch the ideal path of the projectile. [1] D = 0.96
56. How does the maximum altitude of the projectile change as the launch angle is increased from $30^\circ$ to $45^\circ$? [1] D = 0.97
57. How does the total horizontal distance traveled by the projectile change as the launch angle is increased from $30^\circ$ to $45^\circ$ above the horizontal? [Assume the same initial speed, $v_i$.] [1] D = 0.49

June 2006 - Similar Case

A volleyball hit into the air has an initial speed of 10. meters per second. Which vector best represents the angle above the horizontal that the ball should be hit to remain in the air for the greatest amount of time?

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</table>

Claim #4 Mass/Weight

A 2.00 kilogram object weighs 19.6-newtons on Earth. If the acceleration due to gravity on Mars is 3.71 meters per second$^2$, what is the object’s mass on Mars?

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<td>153</td>
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<td>129</td>
<td>1597</td>
<td>74</td>
</tr>
</tbody>
</table>
Mass/Weight
A horizontal force of 8.0 newtons is used to pull a 20.0-newton wooden box moving toward the right along a horizontal, wood surface, as shown.

61. Starting at point P on the diagram in your answer booklet, use a metric ruler and a scale of 1.0 cm = 4.0 N to draw a vector representing the normal force acting on the box. Label the vector $F_N$. [1]

62. Calculate the magnitude of the frictional force acting on the box. (Show all work.) [2]

63. Determine the magnitude of the net force acting on the box. [1]

64. Determine the mass of the box. [1]

65. Calculate the magnitude of the acceleration of the box. [Show all work.] [2]

Conclusions

• Current results parallel data from previous years - difficult topics remain challenging
• Individual results are the most effective tools for program review
• Additional information:
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