Persian Gulf, the Patriot went against a more formidable adversary, Saddam Hussein's homemade "Al-husayn," a modified version of the Soviet SS-1 or Scud. Its range is longer (more than 600 kilometers) and its reentry speed is greater (around Mach 8).

The crudeness of the Scud, Skelly confirmed, worked to its advantage. The U.S. forces were aware that the increased speed of the Al-husayn would challenge the Patriot's capabilities, and so they relied heavily on satellites and other high-powered radar systems to spot and track Scuds at launch and early in their trajectory. What the experts didn't anticipate, though, was that the Iraqi missiles were so ill-made that they would fall apart in flight. As Skelly put it, "Due to poor workmanship, Iraqi Scuds fired at Saudi Arabia and Israel began to break apart during the downward reentry portion of their trajectories, at altitudes of 15 to 20 kilometers." This meant that the Patriot radars picked up many targets, a situation that often causes electronic homing devices to take an average aim at the center of a pattern—not at the crucial part, which in this case would be the leading edge of the missile. To cope with this problem, Skelly said, Raytheon made "rapid software changes" during the war. He claims that as a result, "about half of Scud engagements by Patriots resulted in confirmed destruction of the Scud warhead, as assessed by Israeli Defense Forces." Skelly believes the record was even better in Saudi Arabia, where "just under 90%" of the engagements ended with destruction of the Scud warhead.

This interpretation does not gibe with Postol's information or with the informal opinion of Pedatzur, who says the word in Israel is that the Patriot's success rate in striking warheads, as opposed to the bodies of the missiles, was "very, very low." But Postol himself warns that everyone involved in this debate has an ax to grind, including the Israelis, who are eager to move on to production of the Arrow. This is shaping up into a major debate on the effectiveness of high-tech weaponry that would benefit from an open and impartial review—one which, at this writing, no one is planning.

■ ELIOT MARSHALL

Conventional Math Tests Get Low Marks

Last week, a group of educators, policy makers, and politicians got together at the National Academy of Sciences to rid themselves of their math anxiety. The focus of their concern: Current standardized tests do not adequately assess the ability of U.S. students to solve real world problems.

Though students and teachers have been grumbling about the efficacy of math tests for years, the problem has become acute as curricula are being revamped to put more emphasis on concepts. That makes most standardized tests anachronisms: They still basically assess a student's ability to manipulate numbers. Said Shirley Hill, a mathematician at the University of Missouri at Kansas City, in her keynote address, "What we test is usually what we teach." But, she added, that is not the case today.

There's little disagreement in the education community about the need for new tests and new ways to measure a student's mathematical abilities, but so far reform has been slow. So last week's gathering, grandiosely called the National Summit on Mathematics Assessment, was an attempt to nudge things along. In a sense, it was a show of force from the nation's top education officials—including Education Secretary Lamar Alexander and President Bush, the self-described "education president."

The summit members drafted a statement resolving to focus on developing new assessment instruments for early math education, including a call to eliminate multiple-choice tests for students below the fourth grade. And the statement calls for a variety of tools to be used in assessing mathematical achievement, including portfolios of student work and group work, and the incorporation of problem-solving tools such as calculators and computers into the new assessment mechanisms. Finally, it reasserted the notion that questions on standardized tests should probe reasoning (see example in box).

Summit organizers couldn't have chosen a more propitious time for their meeting. The summit followed on the heels of President Bush's announcement of "America 2000," an ambitious, if ill-funded, plan to "reinvent the American school." Bush, who addressed the summit, reiterated his intention to make American students, "first in the world in math and science by the year 2000." But, he added, "the federal government can only play a limited role. Dollars alone won't get the job done." Among the tools that will facilitate the process, said Bush, is an American Achievement test in the five core subjects—English, mathematics, science, history, and geography—and he challenged summit participants to have a math test for fourth graders ready by 1993. The tests, Bush said, should not "weed kids out" of the drive to be "world-class," but should "promote better math skills for all."

However, whether "all" would be best served by a blanket national exam or by more local assessment was a matter of heated debate. In a session following the president's speech, Colorado Governor Roy Romer questioned whether a national test would be sensitive to differing needs of students in different regions. He proposed instead that four or five regional "assessment instruments" be administered to a "logical grouping of states in the nation."

With debates like this one over basic implementation strategies, this summit agreement will be hard to consummate. Moreover, as education consultant Joan Barron of the Connecticut Department of Education noted, the actual task of developing multifaceted, real world assessment tools may be easier said than done. In her own state, where new forms of assessment are being tried, she said educators found "it was difficult to 'mathematize' the world." "It is difficult to come up with questions that employ multiple strategies." So, the group that convened to discuss math may have gotten a lesson in epistemology. The answer to the question "How will we know that they know what they ought to?" may have to await the next summit.

■ MICHELLE HOFFMAN

A Real World Math Question

Instructions: Use this sheet to solve this problem. Write a complete justification of each solution.

For an upcoming sports vacation, the Smith family has budgeted $250 for some new sports clothing for their children, Mike and Karen. Mike would happily spend the entire $250 on a new pair of sports shoes. Karen wants two new designer sports outfits that cost $85 each. However, Mike must have at least one pair of sports shoes and two athletic shirts. Karen must have at least one new sports outfit, a pair of sandals, and two sweatbands. The sports clothing must be purchased from mail order catalogs.

Use at least three different mail order catalogs to develop two different purchasing plans that you think would satisfy both Mike and Karen. Write a justification for each plan and include shipping charges and tax.

Source: Mathematical Sciences Education Board