LESSON MAKER PRO

Message Math

Measure how much of a transmission carries useful information.

HIGH SCHOOL · FM.IP.A

FM.IP.A "Effective systems for sending and receiving information include components that impact accuracy, efficiency, and security."

NAME _____ DATE _____

USEFUL BITS AND EXTRA BITS

A transmission can include useful data, security bits, and error-check bits. Transmission efficiency is useful bits divided by all bits sent. Extra bits lower efficiency, but they can help protect information or detect errors.

WORKED EXAMPLE

A message has 30 useful bits, a 10-bit security tag, and 10 error-check bits. What is its transmission efficiency?

1. Find all bits sent: 30 + 10 + 10 = 50.
2. Divide useful bits by all bits sent: 30/50 = 3/5.
3. Convert to a percent: 3/5 = 60%.

Answer: 60%

PRACTICE 6 problems

1 A message has 72 useful bits, 12 security bits, and 12 error-check bits. What is its transmission efficiency?

ANSWER _____

2 A message has 64 useful bits, 8 security bits, and 8 error-check bits. What is its transmission efficiency?

ANSWER _____

3 A message has 36 useful bits, 12 security bits, and no error-check bits. How many bits are sent, and what is the transmission efficiency?

ANSWER _____

4 A transmission has 120 bits in all. It contains 84 useful bits and 20 security bits. How many error-check bits does it contain?

ANSWER _____

5 A message originally sends 80 bits, including 64 useful bits. A 16-bit security tag is added. What is its new transmission efficiency?

ANSWER _____

6 Format A sends 108 useful bits, 12 security bits, and 24 error-check bits. Format B sends 108 useful bits, 36 security bits, and no error-check bits. Which format has higher transmission efficiency, or are they equally efficient?

ANSWER _____

APPLY IT Show your work

1 A game lobby message sends 180 useful bits, 36 security bits, and 24 error-check bits. What percentage of the bits sent carry the message?

WORK SPACE

ANSWER _____

2 A digital ticket code has 128 useful bits, 16 security bits, and 16 error-check bits. An error is detected, so the entire transmission is sent a second time. What is the efficiency across both transmissions?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Two apps each deliver three different game alerts. Every alert has 96 useful bits. App A adds 16 security bits and 16 error-check bits per transmission, and one alert is sent a second time. App B adds 32 security bits and 16 error-check bits per transmission, with no alerts sent again. Which app has higher transmission efficiency? Show both efficiencies.

WORK SPACE AND ANSWER

ANSWER KEY # Message Math

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A message has 72 useful bits, 12 security bits, and 12 error-check bits. What is its transmission efficiency?	**75%**
2	A message has 64 useful bits, 8 security bits, and 8 error-check bits. What is its transmission efficiency?	**80%**
3	A message has 36 useful bits, 12 security bits, and no error-check bits. How many bits are sent, and what is the transmission efficiency?	**48 bits; 75%**
4	A transmission has 120 bits in all. It contains 84 useful bits and 20 security bits. How many error-check bits does it contain?	**16 error-check bits**
5	A message originally sends 80 bits, including 64 useful bits. A 16-bit security tag is added. What is its new transmission efficiency?	**66 2/3%**
6	Format A sends 108 useful bits, 12 security bits, and 24 error-check bits. Format B sends 108 useful bits, 36 security bits, and no error-check bits. Which format has higher transmission efficiency, or are they equally efficient?	**They are equally efficient at 75%.**

PART 2 · APPLY IT

1. **75%** The transmission sends 180 + 36 + 24 = 240 bits. Its efficiency is 180/240 = 75%.
2. **40%** Each transmission has 160 bits, so 320 bits are sent. Only one copy of the 128-bit code is useful: 128/320 = 40%.

CHALLENGE

App B. App A sends 4(96 + 16 + 16) = 512 bits, so its efficiency is 288/512 = 56.25%. App B sends 3(96 + 32 + 16) = 432 bits, so its efficiency is 288/432 = 66 2/3%.

Accept equivalent fractions or decimals for efficiencies. Count resent bits in the total sent, but count each distinct message's useful bits only once.