Practice quiz: ASQ Certified Quality Engineer (CQE)

10 questions. The answer key is on page 2.

Name _____ Date _____

1. **How many runs does one replicate of a two-level full factorial experiment with 4 factors need?**
   A. 16
   B. 8
   C. 32
   D. 4

2. **A 2^2 experiment gives these responses: (1) = 12, a = 18, b = 14, ab = 24. What is the main effect of A?**
   A. 8
   B. 16
   C. 4
   D. 2

3. **A 2^2 experiment gives these responses: (1) = 50, a = 60, b = 56, ab = 58. What is the AB interaction effect?**
   A. 4
   B. 6
   C. -4
   D. -8

4. **In a two-factor experiment, raising temperature (A) increases yield by 10 points when pressure (B) is low but lowers it by 2 points when pressure is high. What does this show?**
   A. A has no real effect, because its two effects average out to 4
   B. B has a large main effect, but there is no interaction
   C. The experiment has failed and its runs must be repeated
   D. A strong AB interaction: the effect of A depends on the level of B

5. **A 2^3 experiment gives: (1) = 40, a = 46, b = 42, ab = 50, c = 44, ac = 52, bc = 45, abc = 55. What is the main effect of C?**
   A. 9.0
   B. 2.25
   C. 8.0
   D. 4.5

6. **Using the same 2^3 data, (1) = 40, a = 46, b = 42, ab = 50, c = 44, ac = 52, bc = 45, abc = 55, what is the average response with A at its high level?**
   A. 42.75
   B. 46.75
   C. 50.75
   D. 8.00

7. **In a 2^3 design listed in standard order, (1), a, b, ab, c, ac, bc, abc, which runs carry a plus sign in the AB column?**
   A. a, b, ac and bc
   B. (1), ab, c and abc
   C. ab and abc only
   D. (1), a, b and ab

8. **A half-fraction 2^(4-1) design uses the defining relation I = ABCD. Which effect is aliased with the AB interaction?**
   A. CD
   B. ABC
   C. ABD
   D. BCD

9. **What is the resolution of a 2^(4-1) design with defining relation I = ABCD, and what does it mean for the main effects?**
   A. III; main effects are aliased with two-factor interactions
   B. IV; main effects are clear of two-factor interactions
   C. V; two-factor interactions are also clear of each other
   D. II; main effects are aliased with the other main effects

10. **Why should the runs of a factorial experiment be carried out in a random order?**
    A. To make the columns of the design orthogonal to each other
    B. To stop drifting conditions from biasing the effects
    C. To allow the interaction effects to be estimated at all
    D. To cut the number of runs the design needs

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Answer key

ASQ Certified Quality Engineer (CQE). One line of why for each answer.

1. **A** A two-level full factorial with k factors has 2^k runs: 2^4 = 16.
2. **A** A effect = (18 + 24) / 2 - (12 + 14) / 2 = 21 - 13 = 8.
3. **C** The AB column is + for (1) and ab and - for a and b.
4. **D** When one factor's effect changes with the level of another, the factors interact; here A's effect swings from +10 to -2.
5. **D** C high runs: c, ac, bc, abc = 44 + 52 + 45 + 55 = 196, average 49.0.
6. **C** A high runs: a, ab, ac, abc = 46 + 50 + 52 + 55 = 203, and 203 / 4 = 50.75.
7. **B** The AB sign is the product of the A and B signs, so it is plus when A and B are both low or both high: (1), ab, c and abc.
8. **A** AB x ABCD = A^2 B^2 CD = CD, so AB is aliased with CD.
9. **B** Resolution equals the length of the shortest word in the defining relation, here ABCD, so IV: main effects are aliased only with three-factor interactions, but two-factor interactions are aliased in pairs (AB with CD).
10. **B** Randomizing the run order spreads unknown drifts, such as tool wear or warming equipment, across all factor levels, so they do not line up with one factor and bias its effect.

Full explanations

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