Science Olympiad

Feb 25, 2017   Holt, Michigan
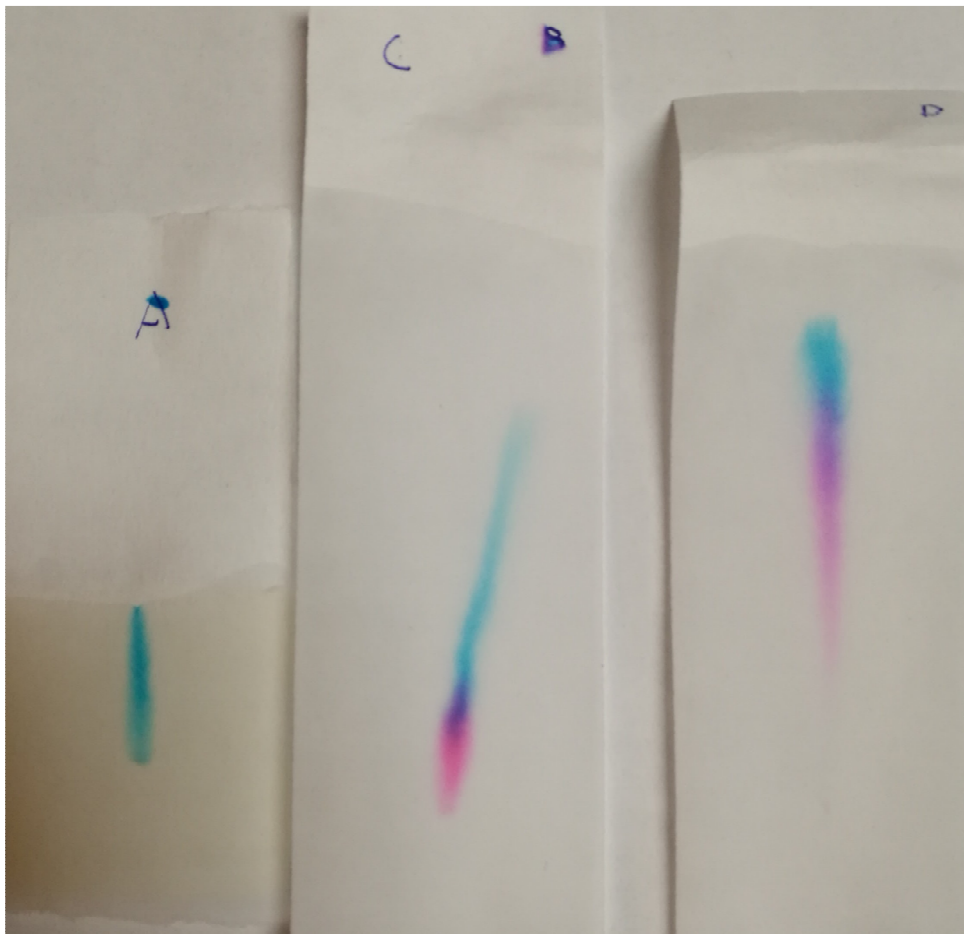
Crime Busters

Answer Key

1. Identify unknown powders

Item	Material name	Brief explanation
CSE-1	Flour (1) and gelatin (1)	Turns blue when Iodide is applied (1) pH < 7 (1) jelly-like when water is applied (1)
CSE-2	Salt (1) and sugar (1)	Two different crystals (1) Dissolve in water at different rates (1) pH=7 (1)
CSE-3	Salt (0.5)	Crystal, pH=7, and dissolves in water slowly (0.5)
CSE-4	Baking soda (0.5)	pH=8, fizzes with HCl (0.5)
CSE-5	Sodium acetate (0.5)	pH=8, no reaction with HCl (0.5)
CSE-6	Gypsum (0.5)	pH=6, no reaction with HCl (0.5)
SEA-1	Flour (0.5)	pH=6, turns blue with I2 (0.5)
SEA-2	Sugar (0.5)	pH=7, dissolves in water quickly (0.5)
SEB-1	Gypsum (0.5)	pH=6, no reaction with HCl (0.5)
SEB-2	Calcium carbonate (0.5)	Insoluble in water, fizzes with HCl (0.5)
SEC-1	Sugar (0.5)	pH=7, dissolves in water quickly (0.5)
SEC-2	Sodium acetate (0.5)	pH=8, no reaction with HCl (0.5)
SED-1	Vitamin C (0.5)	pH=2, turns I2 colorless (0.5)
SED-2	Alka-Seltzer (0.5)	Fizzes in water (0.5)

2. Paper chromatography

1 point for each good paper chromatography

1 point for the answer (B and C match SCE-8)

3. Fiber, hair, and plastic

Item	Material name
CSE-7	Cat hair (1)
CSE-9	Cotton (1)
CSE-10	Polyester (1)

Please circle the one that is the most suitable material for the paint bucket. C(1)

    A) PMMA   B) LDPE   **C) HDPE**   D) Nylon-66

Please circle the one that is the most suitable material for the paintbrush. B(1)

  A) silk   **B) polyester**   C) asbestos   D) Rayon

Please circle the one that can be easily identified by putting it into water. D(1)

    A) LDPE   B) HDPE   C) PP   **D) PS**   E) PVC

Please circle the one that is least likely to be used for a warm winter coat. B(1)

    A) cotton   **B) linen**   C) polyester   D) wool

For HDPE and LDPE, which is stronger and why?

HDPE is stronger. (1)

The polymer chains of LDPE are highly branched compared to HDPE. (1) This branching prevents the chains from stacking neatly beside each other, reducing the intermolecular forces of attraction. This results in a plastic that is softer and more flexible, but which also has lower tensile strength. (1)

4. DNA and tire tread

Identify whose DNA matches the sample collected from the trophy and give a brief explanation.

DNA evidence matches Bill's DNA (1)

Child's DNA comes from both father and mother (1)

CSE-12 indicates the criminal is the child of SEB-5 and SEB-6 (1)

Which of the following does NOT contain DNA?   C(1)

   A) blood   B) Nail   **C) sweat**   D) saliva

Identify whose bike tire matches the track in Mr. Unlucky's backyard and give a brief explanation.

   SEC-5 matches Charles's bike tire tread (2)

   Explanation (2)

5. Crime solution essay

There is no evidence to point Adam (1)

   Flour is common in a bakery (1)

   Sugar is common in a bakery (1)

   SEA-5, His jersey does not match fibers collected at the crime scene. (1)

   CSE-8 does not match SEA-6, His bike tire tread does not match. (1)

Bill is one of the people who broke into Mr. Unlucky's home (1)

Supporting evidence:

      DNA match (1)

      CSE-6 matches SEB-1 (1), gypsum possible from the drywall

      CSE-9 matches SEB-4, Bill's cotton pullover (1)

      SCE-8 matches SEB-3 (1)

      Cat hair (1), Bill's parents have a cat

Charles is one of the people who broke into Mr. Unlucky's home (1)

Supporting evidence:

      CSE-5 matches SEC-2 (1), Sodium acetate is a common food seasoning

      SCE-8 matches SEC-3 (1)

      CSE-10 matches SEC-4, Charles's polyester coat (1)

      CSE-11 matches SEC-5 (1)

      There is nearly a one and a half hour interval between Charles leaving the police station and then appearing on the CVS security camera. So Charles had enough time to break into Mr. Unlucky's home. (1)

There is no evidence pointing to Dan (1)

      Vitamin C is commonly used for the treatment of a cold (1)

      Alka-Seltzer is commonly used for the treatment of a cold (1)

      SED-5 does not match CSE-5 (1)

      SED-4 does not match fibers collected at the crime scene (1)

(3) points for a reasonable explanation of the crime motivation