1. Bob has fair coin that has a 50% chance of landing on heads. If he flips five heads in a row, what is the probability that his sixth flip will result in another head?

Proposed by Shaun Wang.

Answer: $\boxed{\frac{1}{2}}$

Solution: None of Bob's earlier flips matter for the sixth flip's outcome, so the answer is just $\boxed{\frac{1}{2}}$.

2. Sam has 2 identical red coins, 2 identical blue coins, and 2 identical yellow coins. He picks 2 of the 6 coins to go shopping. If he can pick them in any order, how many combinations of colored coins can Sam pick?

Proposed by Kevin Shen.

Answer: $\boxed{6}$

Solution: Sam can either pick 2 coins of the same color, or 2 coins of different colors. There are 3 ways to pick 2 of the same color (RR, BB, YY), and 3 ways to pick 2 of different colors (RB, RY, BY), so the answer is $3 + 3 = \boxed{6}$.

3. Evan is playing a game that has easy levels and hard levels. He has a 50% chance to pass an easy level and a 10% chance to pass a hard level. What is the probability he passes 2 easy levels and 1 hard level, in that order, on his first try?

Proposed by Jeffery Boman.

Answer: $\boxed{\frac{1}{40}}$

Solution: Since each event is independent from each other, we multiply the probabilities of passing together to get $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{10} = \boxed{\frac{1}{40}}$.

4. Bill and David each roll a 20-sided die and add the numbers on their top faces. How many ways are there for them to get a sum of 24?

Answer: $\boxed{17}$

Proposed by Evan Zhang.

Solution: The only valid pairs of rolls where the rolled values are less than or equal to 20 are:

$$(4,20),(5,19),(6,18),\ldots,(19,5),(20,4).$$

Thus, the answer is $20-4+1=\boxed{17}$.

5. The number 4167 is written on the board. Chris goes up to the board and erases two digits at random, leaving a two-digit number. What is the probability the remaining number is even?

Proposed by Kevin Shen.

Answer: $\boxed{\dfrac{1}{3}}$

Solution: Chris needs to erase 3 digits for the units digit of the number to be 4, so the units digit of his number to be 6. For this to happen, Chris needs to remove 7, and then either 4 or 1, so there are 2 ways to get an even number after removing two digits. There are $\binom{4}{2}=4\cdot 3/2=6$ ways to choose two digits to remove at random, so the answer is $\boxed{\dfrac{1}{3}}$.

6. 5 left-handed students and 3 right-handed students randomly choose seats from a row of 8 front-facing desks to take a test. What is the probability that no left-handed person sits directly to the right of a right-handed person?

Proposed by Evan Zhang.

Answer: $\boxed{\dfrac{1}{56}}$

Solution: The condition means that all right-handed people have only non-left handed people to their right. Since there are only left and right handed students, this means either the person to the right of a right-handed student is right-handed, or there is no one to their right. The students must then be sitting such that all right handed students are lined together to the right and all left handed students are thus on the left ($LLLLLRRR$). There are $5!\cdot 3!$ ways to arrange these distinct students. In total, there are $8!$ ways for the students to sit. Thus, the probability is

$$\frac{5!\cdot 3!}{8!}=\frac{1}{\binom{8}{3}}=\boxed{\frac{1}{56}}.$$

7. Thomas rolls a six-sided die 3 times and records the 3 numbers that he rolls. Given that the sum of the 3 numbers is 15, what is the probability he rolled at least one 6?

Proposed by Evan Zhang.

Answer: $\boxed{\dfrac{9}{10}}$

Solution: The only ways to roll a total of 15 is if either all three rolls are 5, if the rolls are 4, 5, and 6 in any of the $3! = 6$ ways, or if the rolls are 3, 6, and 6 in any of the $3!/2! = 3$ ways. This gives us $1 + 6 + 3 = 10$ total ways.

Using complementary counting, the only configuration which doesn't roll a 6 is when all dice rolled 5's. Consequently, the answer is

$$1 - \frac{1}{10} = \boxed{\frac{9}{10}}.$$

8. Three girls, Alice, Allison, and Avery, and three boys, Ben, Bill, and Yixuan, are sitting at a round table with six seats. If rotations are considered the same, how many distinct ways are there for the six people to sit around the table such that every boy sits next to at least one girl and every girl sits next to at least one boy?

Proposed by Kevin Shen.

Answer: $\boxed{84}$

Solution: Consider instead the complement. We wish to find the number of ways for the girls and boys to sit such that there is at least one boy that only sits next to boys, and at least one girl that only sits next to girls. This restricts the orientations to have all of the girls sitting next to each other, and all of the boys sitting next to each other. Within this orientation of GGG, BBB, there are $3! = 6$ ways to permute each girl and boy, so there are $6^2 = 36$ ways for them to sit.

To find the total number of orientations around the table, we can, without loss of generality, fix Alice to be at the top of the table. Then, there are $5! = 120$ ways to place the rest of the 5 people in the 5 remaining seats, and we don't have to worry about rotations since Alice is fixed at the top.

Thus, the answer is $120 - 36 = \boxed{84}$ ways.