Q1. A student takes two tests, A and B. The probability of passing in test A is ½ and the probability of passing in test B is $\frac{2}{3}$. The probability of passing in both tests is $\frac{1}{3}$. Find the probability of passing in at least one of the two tests.

Q2. If p is the mean of the numbers a, b, c, d express in terms of p and k the mean of the numbers $2a + 4, 2b + k, 2c + k, 2d + k$.

Q3. A classroom contains 15 desks which are arranged in rows. The front row contains 3 desks. 15 students are seated at random in the classroom, 8 of whom are boys and 7 of whom are girls. Each desk seats only one student.

What is the probability that;

   (i)   Three girls occupy the front row of desks?
   (ii)   There are more boys than girls seated in the front row?
   (iii)   There are two girls and one boy seated n the front row with the two girls seated next to each other?

Q4. In how many ways can the letters of the word IRELAND be arranged if each letter is used exactly once in each arrangement? In how many of these arrangements do the three vowels come together?

Q5. On an unbiased die, the numbers 1, 3 and 4 are coloured red and the numbers 2, 5 and 6 are coloured black.

   (i)   The die is thrown once. Find the probability of getting an even number or a red number
   (ii)   The die is thrown three times with the following outcome:
           The second throw shows a red number and the sum of the numbers on the first and second throws is equal to the number on the third throw.

Find the probability of this outcome.

Q6. In how many ways can a group of five people be selected from four women and four men? In how many of these groups are there exactly three women?

Q7. Six discs of equal size are stacked one on top of the other. There are two identical red discs and one each of blue, yellow, green and white.

In how many ways can the six discs be stacked so that the two red discs are either at the top or at the bottom?

Q8. Two balls are at the same time taken at random from a box containing three black, three red and three yellow balls.

Find the probability that;

    (i)   Both balls are yellow

    (ii)   Neither of the two balls in yellow

    (iii)   At least one of the balls is yellow.

Q9. An unbiased die is thrown twice. Find the probability of getting a total less than four.

Q10. The points a, b, c, d, e and f lie on a circle.
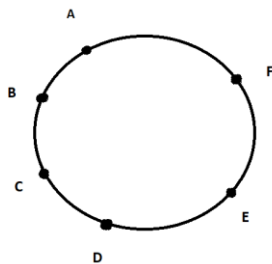
    (i)   If these points are used as vertices, how many different quadrilaterals can be formed?

    (ii)   How many of these quadrilaterals will have [ab] as one side?

Q11. A certain basketball player scores 60% of the free-throw shots she attempts. During a particular game, she gets six free throws.

  a) What assumption(s) must be made in order to regard this as a sequence of Bernoulli trials?

  b) Based on such assumption(s), find, correct to three decimal places, the probability that:

    (i)   She scores one exactly four of the six shots

    (ii)   She scores for the second time on the fifth shot.

Q12. A company produces calculator batteries. The diameter of the batteries is supposed to be 20 mm. The tolerance is 0.25 mm. Any batteries outside this tolerance are rejected. You may assume that this is the only reason for rejecting the batteries.

a) The company has a machine that produces batteries with diameters that are normally distributed with mean 20mm and standard deviation 0.1 mm. Out of every 10 000 batteries produced by this machine, how many, on average, are rejected?

b) A setting on the machine slips, so that the mean diameter of the batteries increases to 20.05mm, while the standard deviation remains unchanged. Find the percentage increase in the rejection rate for batteries from this machine.

Q13.

a) Explain each following terms;
   (i)   Sample space
   (ii)   Mutually exclusive events
   (iii)   Independent events

b) In a class of 30 students, 20 study Physics, 6 study Biology and 4 study both Physics and Biology.
   (i)   Represent the information on a Venn Diagram

A student is selected at random from this class. The events E and F are:

E: The student studies Physics

F: The student studies Biology

   (ii)   By calculating probabilities, investigate if the events E and F are independent.

Q14. The random variable X has a discrete distribution. The probability that it takes a value other than 13, 14, 15 or 16 is negligible.

a) Complete the probability distribution table below and hence calculate E(X), the expected value of X.

x	13	14	15	16
P(X=x)	0.383	0.575		0.004

b) If X is the age, in complete years, on 1ˢᵗ January 2013 of a student selected at random from among all second-year students in Irish schools, explain what E(X) represents.

c) IF ten students are selected at random from this population, find the probability that exactly six of the, were 14 years old on 1ˢᵗ January 2013. Give your answer correct to three significant figures.

Q15. The events A and B are such that $P(A) = 0.7$ and $P(B) = 0.5$ and $P(A \cap B) = 0.3$.

Find

a) $P(A \cup B)$

b) $P(A \setminus B)$

c) State whether A and B are independent events, and justify your answer.