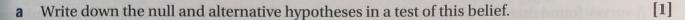1 A certain variety of sweet pea produces flowers of various colours. Plants with yellow flowers are particularly prized. A random sample of n plants is chosen to test, at the 5% significance level, whether or not the proportion of plants with yellow flowers is $\frac{1}{2}$

   a If n is the sample size and p is the proportion of plants producing yellow flowers, write down the null and alternative hypotheses for this test. **[1 mark]**

   b If $n = 6$, find the critical region, giving the probability of incorrectly rejecting H_0 **[5]**

2 A random variable X has a binomial distribution with parameters $n = 10$ and p, a constant. The value of p was known to be 0.4 but is now believed to have increased.

   a Write down the null and alternative hypotheses in a test of this belief. **[1]**

   b Use a significance level of 5% to determine the values of X that would suggest the belief is incorrect. **[4]**

40% of days in Leuchars during the summer of 1987 had over 6 hours of sunshine. In 2015, a random sample of 10 summer days was taken and 8 of them were found to have over 6 hours of sunshine.

   c Use your answer to parts **a** and **b** to state whether you believe that the proportion of days with over 6 hours of sunshine has changed during that time period. **[1]**

3 You wish to investigate whether a coin is biased towards heads. You toss the coin 5 times and note the number of heads showing.

   a Given that the number of heads is 4, perform a 5% significance test, stating clearly your null and alternative hypotheses. **[5]**

   b Would your conclusion change if the number of heads showing was 5? **[1]**

4 It is estimated that 40% of cars on the road have a mechanical defect which breaks current road traffic regulations. A sample of 20 cars were examined and 6 were found to have such defects.

   a State a condition on the method of choosing the sample so that a binomial probability model can be used to test the estimate. **[1]**

   b Assuming that the condition in part **a** is met, test at a 5% significance level whether the data suggests that 40% is an overestimate. You should state clearly your null and alternative hypotheses. **[4]**

5 Over a long period, 6 out of every 10 adults who were asked agreed with the statement 'annual snowfall has decreased over the last 10 years'. This year, in an independent random sample of 12 adults, 10 agreed with the statement.

Is there evidence that the proportion of adults holding this view has increased? You should use a 10% significance level and describe the critical region. **[5]**

6 The summer maximum daily temperature in 2015 in Leeming was above 17.5 °C on 82% of all days. A random sample of 14 summer days were considered in 1987 and 13 of these had temperatures above 17.5 °C. It is suggested that this data shows that temperatures were higher in Leeming in 1987 than in 2015

   a Explain why the binomial probability distribution provides a good model for this experiment.   [2]

   b Copy and complete the following table for X, a random variable for the number of summer days with a maximum temperature above 17.5 °C *in 2015*   [2]

x	11	12	13	14
$P(X=x)$	0.2393	0.2725		

   c Test, using a 10% significance level, whether the suggestion is justified.   [3]

7 A survey found that 60% of documents printed in an office were printed single-sided. Employees were asked not to print single-sided in order to save paper. A fortnight later the manager of the office wanted to see if there had been any reduction in the rate of single-sided printing. He tested 40 documents and found that 18 of them had been printed single-sided.

   a State the hypotheses clearly.   [1]

   b If he concluded that there had been an improvement, using a significance level of $a\%$, what is the lowest possible whole number value of a?   [3]

8 It is known that 35% of all days at Heathrow airport have a mean daily windspeed above 23 mph. Somebody claims that this proportion is lower at Gatwick airport. A sample of 30 days found that there was a mean daily windspeed above 23 mph on 8 of the days. A statistical test is carried out to determine whether windspeeds are lower at Gatwick airport than at Heathrow.

   a State a condition for the sample to be suitable for use in the test and state why the condition is necessary.   [2]

   Let X be a random variable for the number of days with a mean daily windspeed above 23 mph in a sample of size 30 at Gatwick airport.

   b State the null and alternative hypotheses to be used in the test and, assuming that the null hypothesis is true, give the distribution of X [2]

   c Perform this test at a significance level of 5%   [3]

9 $X \sim B(n,p)$ and

   $H_0: p = k$ $H_1: p > k$

   The critical value is $n-1$

   a Find the probability that X is in the critical region in terms of k and n [4]

   b If $n = 2$ and the significance level is at least 19% then find an inequality for k [5]