1 For two events A and B, it is known that $P(A)=0.3$, $P(B|A)=0.4$ and $P(B'|A')=0.35$

a Represent this information on a tree diagram showing all the individual probabilities. **[6 marks]**

b Use your tree diagram to calculate $P(B)$ **[3]**

c Represent the information on a Venn diagram. **[6]**

2 Weather conditions are recorded in Heathrow over six months in 2015. The data shows the number of days on which the temperature exceeded 25°C (heatwaves) and the number of days on which there was at least 1 mm of rain (rainy days).

	Heat-wave	Not heat-wave	
Rainy	2	41	43
Not rainy	20	121	141
	22	162	184

a Calculate the probability that a randomly-chosen day

i Had a heatwave.

ii Was dry given that there was a heatwave.

iii Was dry.

iv Had a heatwave given that it was dry. **[6]**

b If another day in the past is known to be dry, would you assume it had a heatwave? **[1]**

3 Between 05:30 and 22:30 inclusive, 171 number 1 buses arrive at a given bus stop.

a Calculate the average length of time between bus arrivals. **[3]**

b Assuming the buses arrive at regular intervals and never run late, what is the probability that a bus arrives between 08:30 and 08:40? **[2]**

c Discuss whether your answer to part **b** is reasonable for a real bus service, and state any assumptions that are likely to be wrong. **[1]**

4 For each of the following Normal distributions, calculate the probabilities to three significant figures.

a For $X \sim N(4,3)$ find $P(X<2.3)$ **[2]**

b For $X \sim N(-4,21)$ find $P(X>-0.5)$ **[2]**

c For $X \sim N(17,4)$ find $P(X=16)$ **[1]**

5 For $X \sim N(4,4)$, $P(X<2)=0.15866$ and $P(X>7)=0.066807$ to five significant figures.

a Use this information to calculate $P(2<X<7)$ to three significant figures. **[3]**

b Express the following probabilities in terms of X and use the information above to calculate their values to 3 significant figures.

i $P(4<Y)$, where $Y \sim N(8, 16)$

ii $P(Z<-1)$, where $Z \sim N(0, 1)$

iii $P(W<-12 \text{ or } W>-2)$, where $W \sim N(-8, 16)$ **[7]**

6 The distance an amateur archer lands an arrow from the centre of the target is modelled by a Normal distribution, with mean 0 cm and variance 100 cm^2

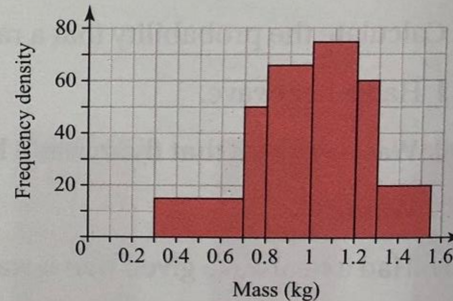
a Find the probability that the arrow lands within 3 cm of centre of the target. **[1]**

b The archer shoots ten arrows, one after the other. Assuming the arrows are shot independently, find the probability that at least three arrows land within 3 cm of the centre. **[3]**

c Is it reasonable to expect that the arrows have independent probabilities of landing within 3 cm of the centre? **[1]**

d In each round of a competition, the archers need to land three out of ten arrows within 3 cm of the centre to score a point for that round. The archer who scores the most points over five rounds wins. Assuming each round is independent of the others, find the expected number of points the archer in this question will score. **[2]**

7 50 bags of flour are weighed and their masses are recorded in a histogram.



a Calculate estimates for the mean and variance of the data to 2 decimal places. **[4]**

b Let X be the mass of a randomly chosen bag. Show that X can be modelled by a Normal distribution. **[5]**

c Use the Normal model from part **b** to calculate

i $P(X<1)$ ii $P(X \geq 0.7)$ iii $P(X \leq 1.36)$ **[3]**

d Use the Normal model from part **b** to write the interval, centred at the mean, that 99.8% of the data lies in. **[1]**

8 A casino uses a dice testing machine to ensure a dice is rolling the right number of sixes.

a Assuming the dice is fair

i Calculate μ, the expected number of sixes in ten rolls,

ii Calculate the variance in the number of sixes over ten rolls,

iii Calculate $\mu+\frac{\sqrt{10}}{2}$ and $\mu-\frac{\sqrt{10}}{2}$

iv Find the probability that in ten rolls the number of sixes rolled is within $\frac{\sqrt{10}}{2}$ of the expected number. **[6]**

b If the dice is rolled n times, where n is a large number, state a suitable approximate distribution for the number of sixes rolled. **[2]**

c Calculate the probability that over n rolls, the number of sixes rolled is within $\frac{\sqrt{n}}{2}$ of the expected number, for

i $n=900$ ii $n=10000$ iii $n=1000000$ **[9]**