

Total Questions: 9

Total Marks: 78

Question 1:

Calculator Allowed: No

[Maximum mark: 7]

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Let X be a random variable which follows a normal distribution with mean μ . Given that $P(X < \mu - 5) = 0.2$, find

(a) $P(X > \mu + 5)$; [2]

(b) $P(X < \mu + 5 \mid X > \mu - 5)$. [5]

Question 2:

Calculator Allowed: Yes

3. [Maximum mark: 7]

The total number of children, y , visiting a park depends on the highest temperature, T , in degrees Celsius ($^{\circ}\text{C}$). A park official predicts the total number of children visiting his park on any given day using the model $y = -0.6T^2 + 23T + 110$, where $10 \leq T \leq 35$.

- (a) Use this model to estimate the number of children in the park on a day when the highest temperature is 25°C . [2]

An ice cream vendor investigates the relationship between the total number of children visiting the park and the number of ice creams sold, x . The following table shows the data collected on five different days.

Total number of children (y)	81	175	202	346	360
Ice creams sold (x)	15	27	23	35	46

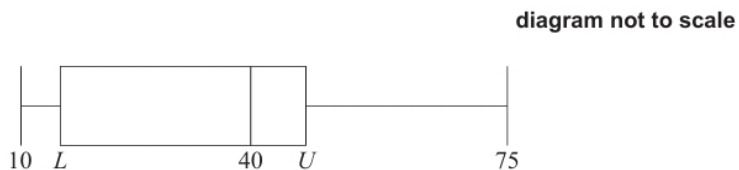
- (b) Find an appropriate regression equation that will allow the vendor to predict the number of ice creams sold on a day when there are y children in the park. [3]
- (c) Hence, use your regression equation to predict the number of ice creams that the vendor sells on a day when the highest temperature is 25°C . [2]

Question 3:

Calculator Allowed: No

3. [Maximum mark: 5]

A research student weighed lizard eggs in grams and recorded the results. The following box and whisker diagram shows a summary of the results where L and U are the lower and upper quartiles respectively.



The interquartile range is 20 grams and there are no outliers in the results.

- (a) Find the minimum possible value of U . [3]
- (b) Hence, find the minimum possible value of L . [2]

Question 4:

Calculator Allowed: Yes

10. [Maximum mark: 16]

A farmer is growing a field of wheat plants. The height, H cm, of each plant can be modelled by a normal distribution with mean μ and standard deviation σ .

It is known that $P(H < 94.6) = 0.288$ and $P(H > 98.1) = 0.434$.

- (a) Find the probability that the height of a randomly selected plant is between 94.6 cm and 98.1 cm. [2]
- (b) Find the value of μ and the value of σ . [5]

The farmer measures 100 randomly selected plants. Any plant with a height greater than 98.1 cm is considered ready to harvest. Heights of plants are independent of each other.

- (c) (i) Find the probability that exactly 34 plants are ready to harvest.
- (ii) Given that fewer than 49 plants are ready to harvest, find the probability that exactly 34 plants are ready to harvest. [6]

In another field, the farmer is growing the same variety of wheat, but is using a different fertilizer. The heights of these plants, F cm, are normally distributed with mean 98.6 and standard deviation d . The farmer finds the interquartile range to be 4.82 cm.

- (d) Find the value of d . [3]

Question 5:

Calculator Allowed: Yes

[Maximum mark: 7]

The following table below shows the marks scored by seven students on two different mathematics tests.

Test 1 (x)	15	23	25	30	34	34	40
Test 2 (y)	20	26	27	32	35	37	35

Let L_1 be the regression line of x on y . The equation of the line L_1 can be written in the form $x = ay + b$.

- (a) Find the value of a and the value of b . [2]

Let L_2 be the regression line of y on x . The lines L_1 and L_2 pass through the same point with coordinates (p, q) .

- (b) Find the value of p and the value of q . [3]

- (c) Jennifer was absent for the first test but scored 29 marks on the second test. Use an appropriate regression equation to estimate Jennifer's mark on the first test. [2]

Question 6:

Calculator Allowed: Yes

1. [Maximum mark: 7]

In Lucy's music academy, eight students took their piano diploma examination and achieved scores out of 150. For her records, Lucy decided to record the average number of hours per week each student reported practising in the weeks prior to their examination. These results are summarized in the table below.

Average weekly practice time (h)	28	13	45	33	17	29	39	36
Diploma score (D)	115	82	120	116	79	101	110	121

- (a) Find Pearson's product-moment correlation coefficient, r , for these data. [2]

- (b) The relationship between the variables can be modelled by the regression equation $D = ah + b$. Write down the value of a and the value of b . [1]

- (c) One of these eight students was disappointed with her result and wished she had practised more. Based on the given data, determine how her score could have been expected to alter had she practised an extra five hours per week. [2]

- (d) Lucy asserts that the number of hours a student practises has a direct effect on their final diploma result. Comment on the validity of Lucy's assertion. [1]

Lucy suspected that each student had not been practising as much as they reported. In order to compensate for this, Lucy deducted a fixed number of hours per week from each of the students' recorded hours.

- (e) State how, if at all, the value of r would be affected. [1]

Question 7:

Calculator Allowed: Yes

3. [Maximum mark: 17]

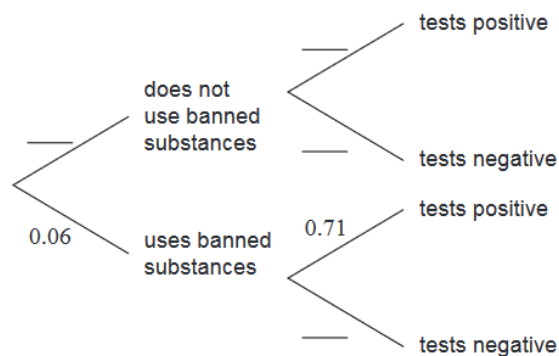
A large international sports tournament tests their athletes for banned substances. They interpret a positive test result as meaning that the athlete uses banned substances. A negative result means that they do not.

The probability that an athlete uses banned substances is estimated to be 0.06.

If an athlete **uses** banned substances, the probability that they will test positive is 0.71.

If an athlete does **not use** banned substances, the probability that they will test negative is 0.98.

- (a) Using the information given, **copy** (into your answer booklet) and complete the following tree diagram. [2]



- (b) (i) Determine the probability that a randomly selected athlete does not use banned substances and tests negative.
- (ii) If two athletes are selected at random, calculate the probability that both athletes do not use banned substances and both test negative. [4]

- (c) (i) Calculate the probability that a randomly selected athlete will receive an incorrect test result.
- (ii) A random sample of 1300 athletes at the tournament are selected for testing. Calculate the expected number of athletes in the sample that will receive an incorrect test result. [5]
- Team X are competing in the tournament. There are 20 athletes in this team. It is known that none of the athletes in Team X use banned substances.
- (d) Calculate the probability that none of the athletes in Team X will test positive. [4]
- (e) Determine the probability that more than 2 athletes in Team X will test positive. [2]

Question 8:

Calculator Allowed: Yes

16. [Maximum mark: 6]

When Jef plays basketball, the number of shots he takes during any 6 minutes of play can be modelled by a Poisson distribution with mean 2.5.

- (a) Find the probability that Jef takes less than 7 shots during any 12 minutes of play. [2]

It can be assumed that the outcomes of the shots are independent of each other, and the probability of success of a shot is constant. The probability that Jef is successful with a shot is 0.4.

It can be assumed that the probability of Jef's success with a shot is independent of the number of shots that he takes.

- (b) Find the probability that during any 6 minutes of play Jef takes fewer than 4 shots and is successful at least once. [4]

Question 9:

Calculator Allowed: No

10. [Maximum mark: 6]

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The ten numbers x_1, x_2, \dots, x_{10} have a mean of 10 and a standard deviation of 3.

Find the value of $\sum_{i=1}^{10} (x_i - 12)^2$.