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| EGC_Black | **MATHEMATICS: SPECIALIST 3 & 4**  **SEMESTER 2 2016**  **TEST 6**  **Calculator Free** |

Reading Time: 2 minutes

Time Allowed: 16 minutes Total Marks: 16

**1.** [3, 4 marks]

A particle moves in a straight line and, at time seconds, the displacement from a fixed origin is metres, while denotes the velocity .

(a) If , and when , find the value of for which next has the value .

(b) If the particle moves in the region , and , find the acceleration when .

**2.** [2, 3, 2, 2 marks]

(a) A researcher was constructing a confidence interval for the average length of time it took for subjects to complete a puzzle. Would increasing the number of subjects increase or decrease the width of the confidence interval? Justify your answer.

(b) Given that a confidence interval corresponds to a z-score of , determine a confidence interval for the average length of a piece of string given that pieces of string had a mean length of cm with a standard deviation of cm.

(c) The length of time between phone calls at a call centre is exponentially distributed with both a mean and a standard deviation of minutes. The length of time between phone calls is recorded. Let be the average time between these phone calls. Describe the distribution that a large number of samples of would follow.

(d) When a fair, standard ten-sided die is rolled, then the outcome forms a uniform probability distribution, with a mean of and a standard deviation of (to d.p.)

In an experiment, fair, standard, ten-sided dice are rolled and the mean for the rolls is calculated. The experiment is repeated times, and the mean and standard deviation of the means is calculated.

Andrew, Kelly and Patsy each performed the above procedure. One used dice, another and another (that is, or or ).

Andrew’s results were: mean = and standard deviation =

Kelly’s results were: mean = and standard deviation =

Patsy’s results were: mean = and standard deviation =

Who was the person who was *most likely* to have rolled dice (ie )? Justify your answer.

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| EGC_Black | **MATHEMATICS: SPECIALIST 3 & 4**  **SEMESTER 2 2016**  **TEST 6**  **Calculator Assumed** |

Reading Time: 3 minutes

Time Allowed: 25 minutes Total Marks: 25

**3.** [3, 2 marks]

(a) A particle moves with Simple Harmonic Motion. If its acceleration at distance metres from the mean position is , prove that the period of the motion is .

(b) At the end of three successive seconds the distances of a particle moving with Simple Harmonic Motion as measured from its mean position are , and metres. Find the period of the motion.

**4.** [1, 3, 3, 2 marks]

A major bank was concerned that customers who rang the customer service phone line were waiting too long to be served. A random sample of phone calls found that the wait time was normally distributed with a mean of minutes and a standard deviation of minutes.

(a) What is the probability that a customer had to wait for between and minutes to be served?

(b) Construct a confidence interval for the actual mean wait time to be served.

(c) How many phone calls should the bank sample in order to be 99% confident that the mean wait time for the samples was within seconds of the actual mean wait time?

(d) The bank manager states that the average waiting time for customers who rang the customer service phone line was less than 8 minutes. Does the data support his comment? Justify your answer.

**5.** [3, 3, 2, 3 marks]

A zoologist studying the rare Bigaitch Scrubrat captures a random sample of Bigaitch Scrubrats. She determines that the mean weight of these Scrubrats was kg with a standard deviation of kg.

(a) Calculate a confidence interval for the true mean weight of Bigaitch Scrubrats.

Twelve years later the zoologist does a follow-up research project and captures another sample of Bigaitch Scrubrats.

(b) Determine the probability that these scrubrats have a mean weight in excess of kg.

State the distribution being used with all parameters.

The zoologist discovers that these scrubrats have a mean of kg with a standard deviation of kg.

(c) State, with reason, what the zoologist could conclude about this second sample of Bigaitch Scrubrats.

(d) How big a sample of scrubrats would the zoologist need to take if she wanted a confidence interval of the true mean to have a total width of kg?