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|  | **MATHEMATICS: SPECIALIST 3 & 4**  **SEMESTER 2 2019**  **TEST 6**  **Calculator Free** |

Reading Time: 2 minutes

Time Allowed: 17 minutes Total Marks: 17

**1.** [3 marks]

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

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

**2.** [5 marks]

A particle in Simple Harmonic Motion travels from rest to rest, a distance of 30m in 5 seconds.

Find the particle’s:

(a) maximum speed. (3 marks)

(b) minimum acceleration and its displacement relative to the mean position at this instant. (2 marks)

**3.** [9 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.

(2 marks)

(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. (3 marks)

(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. (2 marks)

(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.

(2 marks)

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|  | **MATHEMATICS: SPECIALIST 3 & 4**  **SEMESTER 2 2019**  **TEST 6**  **Calculator Assumed** |

Reading Time: 2 minutes

Time Allowed: 25 minutes Total Marks: 23

**4.** [11 marks]

A particle moves along a straight line. The displacement of the particle from the origin is  cm and its velocity is  cms-1. The particle is moving such that.

(a) Determine the acceleration of the particle and hence show that the motion of the particle is simple harmonic with period . (2 marks)

(b) Given the initial position of the particle was at the centre of oscillation, determine an expression for the displacement of the particle as a function of time. (2 marks)

(c) Find the maximum and minimum speed of the particle. (2 marks)

(d) Determine the distance travelled by the particle during the fourth second correct to two decimal places.

(3 marks)

(e) Is the particle travelling towards or away from the initial position at  seconds? Justify your answer.

(2 marks)

**5.** [12 marks]

People living a certain city are susceptible to migraine attacks. The number of migraines suffered by each person in any given week is known to be normally distributed, with a mean 5.04 and a standard deviation of 1.8.

Researchers plan to test the effectiveness of acupuncture as treatment for migraine. They began by using acupuncture on a small random sample, and they found that for people in this sample the average number of migraines per week was 3.81, with a standard deviation of 1.3.

1. They now wish to use a larger sample to estimate the average number of migraines per week that would be suffered by people treated with acupuncture, to an accuracy of 0.2 at a 95% level of confidence.

How large does the sample need to be? Use the standard deviation from the preliminary trial to make your estimate. (3 marks)

1. In a random sample of 200 people treated with acupuncture it is found that the average number of migraines is 4.55, with a standard deviation of 1.36.

Calculate a 95% confidence interval for the average number of migraine attacks suffered by people treated with acupuncture. (3 marks)

1. Comment on the claim that ‘the testing clearly shows that acupuncture reduces the frequency of migraine’ attacks. (2 marks)
2. Researchers also tested an alternative treatment for migraine attacks. They found that for the 100 hundred randomly selected people who were given a certain drug, the average number of migraine attacks was 4.18, with a standard deviation of 2.43.

Use a confidence interval to test the claim that ‘these tests clearly show that the drug is more effective than acupuncture for treating migraine attacks’. (4 marks)