$\hat{p}\mathbb{R}\sigma\hat{j}e\mathbb{C}\tau^{152}$ Phase 27   Tech Active

Question 1

QUESTION 1

The time taken to complete orders at a pizza store is normally distributed with a mean time (μ) of 10 minutes.

The owner of the pizza store records the time taken to complete orders for a random sample of 20 pizzas each day over a 30-day period. From this data, an approximate 90% confidence interval for μ is calculated at the end of each day.

How many of these confidence intervals would be expected to contain μ?

(A)   3

(B)   18

(C)   27

(D)   30

Question 2

QUESTION 9

Two vertical forces act on a skydiver with a mass of 85 kg, as shown.

When the magnitude of the air resistance is 62 N, the magnitude of the acceleration of the skydiver is

(A)   0.73 m s^{-2}

(B)   2.65 m s^{-2}

(C)   9.07 m s^{-2}

Question 3

QUESTION 12 (9 marks)

For a certain experiment, the number of yeast cells, N, after t hours in a test tube can be modelled by the differential equation

$$\frac{dN}{dt} = \frac{1}{1000} N(1000 - N) \text{ for } t \geq 0$$

a)   Given $\dfrac{1000}{N(1000-N)} = \dfrac{1}{N} + \dfrac{1}{1000-N}$, show that the general solution of the differential

equation can be expressed as

$$\ln\left|\frac{N}{1000-N}\right| = t + c$$

[2 marks]

A scientist commenced this experiment at 9:00 am on a certain day and observed that 100 yeast cells were present at this time.

b)   Show that the solution of the differential equation can be expressed as

$$N = \frac{1000}{1 + 9e^{-t}}$$

[3 marks]

c)   Determine the time of day when 900 yeast cells were present.   *[2 marks]*

The scientist predicted that the number of yeast cells would eventually exceed 1200.

d)   Evaluate the reasonableness of the scientist's prediction.   *[2 marks]*

Question 4

QUESTION 17 (6 marks)

The mass of a population of elephants is known to be normally distributed.

A biologist randomly selects a number of elephants from this population and measures their masses. The mean mass of the sample is 5206 kg with a standard deviation of 356 kg.

The biologist uses the data to calculate a 90% confidence interval for the population mean mass of (5159.1, 5252.9) kg.

Determine a 99% confidence interval for the population mean mass based on the same data.

Question 5

QUESTION 19 (7 marks)

A research organisation plans to use a drone to drop a scientific instrument vertically from a stationary position above the ocean surface. The acceleration $\left(\text{m s}^{-2}\right)$ of the falling instrument can be modelled by $9.8 - 0.1v$, where v is its velocity $\left(\text{m s}^{-1}\right)$.

In order for the instrument sensors to activate, its speed as it hits the ocean surface must reach at least 20 m s^{-1}. However, if it hits with a speed above 50 m s^{-1}, the sensors will be damaged.

Determine the range of the drone's flying height above the ocean surface to ensure that the sensors are activated but not damaged.