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TUTGATHER PRACTICE PAPER

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2027

MATHEMATICS Extended Part Module M1
PAPER

Question-Answer Book

Candidate Number

TUTGATHER
PRACTICE PAPER · NOT AN OFFICIAL HKEAA PAPER

1 hour 5 minutes

This paper must be answered in English

Topic practice: Standardisation of a Normal Variable

INSTRUCTIONS

(1) This paper consists of THREE sections, A(1), A(2) and B.

(2) Attempt ALL questions in this paper. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins.

(3) Unless otherwise specified, all working must be clearly shown.

(4) Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.

(5) The diagrams in this paper are not necessarily drawn to scale.

(6) Calculators and mathematical drawing instruments may be used.

(7) The marks for each question are shown in brackets.

(8) No extra time will be given after the 'Time is up' announcement.

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SECTION A(1) (16 marks)

1. Let Z be the standard normal variable. Using the standard normal table, find **(3 marks)**

   (a) $P(Z < 1.35)$;

   (b) $P(Z > -0.62)$;

   (c) $P(-1.20 < Z < 0.85)$.

   Give your answers correct to 4 decimal places.

2. The masses of apples in an orchard are normally distributed with mean 150 g and standard deviation 12 g. An apple is chosen at random. Let X be its mass. **(3 marks)**

   (a) Write down the standardised variable Z corresponding to X.

   (b) Find the probability that the apple has a mass less than 168 g.

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3. Let Z be the standard normal variable. It is given that $P(Z < k) = 0.8849$ and $P(Z > m) = 0.0228$. **(4 marks)**

(a) Find the value of k.

(b) Find the value of m.

(c) Hence find $P(m < Z < k)$ correct to 4 decimal places.

4. Let Z be the standard normal variable. **(6 marks)**

(a) Show that $P(Z < -a) = 1 - P(Z < a)$ for any real number a.

(b) Using the result of (a) and the standard normal table, find the value of c (correct to 2 decimal places) such that $P(|Z| < c) = 0.90$.

(c) Hence find $P(Z < -c)$ and $P(Z > c)$ for this value of c.

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SECTION A(2) (24 marks)

5. The lifetimes of a certain brand of battery are normally distributed with mean μ hours and standard deviation σ hours. It is known that 5% of the batteries last less than 40 hours and 10% last more than 58 hours. **(7 marks)**

(a) Write down two equations in μ and σ by standardising.

(b) Hence find μ and σ correct to 3 significant figures.

(c) Find the probability that a randomly chosen battery lasts between 45 and 55 hours.

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6. The scores in a test are normally distributed with mean 62 and standard deviation 10. **(8 marks)**

(a) Find the probability that a randomly chosen candidate scores more than 75.

(b) The top 8% of candidates are awarded a distinction. Find the minimum score needed for a distinction, correct to the nearest integer.

(c) A sample of 5 candidates is chosen at random. Find the probability that at least 2 of them score more than 75.

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7. Let Z be the standard normal variable and let $\Phi(a) = P(Z < a)$. **(9 marks)**

(a) Express $P(Z > a)$ and $P(Z < -a)$ in terms of $\Phi(a)$.

(b) It is given that $\Phi(1.96) = 0.9750$. Find the value of a such that $P(-a < Z < a) = 0.95$.

(c) A machine fills bottles with a volume that is normally distributed with mean 500 mL and standard deviation 4 mL. A bottle is rejected if its volume differs from 500 mL by more than d mL. Given that 5% of bottles are rejected, find d correct to 2 decimal places.

(d) Using the value of d from (c), find the probability that a bottle is rejected given that its volume exceeds 500 mL.

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SECTION B (10 marks)

8. Two factories A and B produce metal rods. The lengths of rods from A are normally distributed with mean μ_A cm and standard deviation σ_A cm, and those from B are normally distributed with mean μ_B cm and standard deviation σ_B cm. For factory A, 2.5% of rods are shorter than 9.80 cm and 2.5% are longer than 10.20 cm. For factory B, 10% of rods are shorter than 9.70 cm and 5% are longer than 10.15 cm. **(10 marks)**

(a) Find μ_A and σ_A.

(b) Find μ_B and σ_B correct to 3 significant figures.

(c) A rod is chosen at random from each factory. Find the probability that the rod from A is longer than the rod from B.

(d) Rods are accepted only if their lengths lie between 9.75 cm and 10.25 cm. Which factory has the smaller proportion of rejected rods? Justify your answer.

END OF PAPER

Answers written in the margins will not be marked.
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