IB MATHS AA HL · UNIT 4

Normal Distribution: exam practice

10 questions · 34 marks · worked solutions and markschemes

Name _____ Date _____ Score / 34

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/hlaa/normal-distribution-exam-practice

1. **2 marks · Paper 2 style · calculator**

Test scores are normally distributed with mean 62 and standard deviation 11. The top 10% of students get a merit.

Find the lowest score that gets a merit. **[2]**

2. **2 marks · Paper 1 style · no calculator**

$X \sim N(30,\ 4^2)$ and $P(X < 26) = 0.159$, to 3 significant figures.

Without a calculator, find $P(26 < X < 34)$. **[2]**

3. **3 marks · Paper 2 style · calculator**

The lifetimes of batteries are normally distributed with mean 420 hours and standard deviation 35 hours.

Find the interquartile range of the lifetimes. **[3]**

4. 3 marks · Paper 2 style · calculator

Commute times are $N(34,\ 6^2)$ minutes. Given that a commute takes longer than 30 minutes, find the probability it takes longer than 40 minutes.

Find this probability. **[3]**

5. 3 marks · Paper 2 style · calculator

The weights of bags of rice are normally distributed with mean μ g and standard deviation 8 g. 5% of bags weigh less than 500 g.

Find μ. **[3]**

6. 3 marks · Paper 2 style · calculator

$X \sim N(80, \sigma^2)$ and $P(X > 95) = 0.06$.

Find σ. **[3]**

7. 5 marks · Paper 2 style · calculator

$X \sim N(\mu, \sigma^2)$ with $P(X < 40) = 0.2$ and $P(X > 65) = 0.1$.

Find μ and σ. **[5]**

8. 4 marks · Paper 2 style · calculator

The lengths of bolts are normally distributed with mean 50 mm and standard deviation 0.8 mm.

(a) Find the probability that a bolt is shorter than 49 mm. **[2]**

(b) Find the probability that a bolt is between 49.5 mm and 51 mm. **[2]**

9. 4 marks · Paper 2 style · calculator

A machine fills cartons with $N(1005,\ 4^2)$ ml of juice. A carton is underfilled if it holds less than 1000 ml.

(a) Find the probability that a carton is underfilled. **[2]**

(b) Find the expected number of underfilled cartons in a batch of 500. **[2]**

10. 5 marks · Paper 2 style · calculator

The heights of students are $N(168,\ 9^2)$ cm. 12 students are chosen at random.

(a) Find the probability that a student is taller than 180 cm. **[2]**

(b) Find the probability that exactly 2 of the 12 students are taller than 180 cm. **[3]**

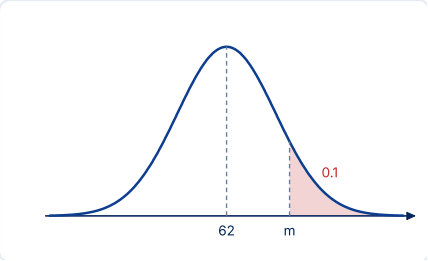
Answers and worked solutions

Question 1 — 2 marks

Answer: 76.1

$P(X > m) = 0.1$ **M1**

$m = 76.1$ **A1**



$P(X > m) = 0.1$

Question 2 — 2 marks

Answer: 0.682

symmetry: $P(X > 34) = 0.159$ **M1**

$1 - 2(0.159) = 0.682$ **A1**

Question 3 — 3 marks

Answer: 47.2 hours

$Q_1 = 396.4$ **A1**

$Q_3 = 443.6$ **A1**

IQR $= 47.2$ hours **A1**

Question 4 — 3 marks

Answer: 0.212

$\frac{P(X > 40)}{P(X > 30)}$ **M1**

$\frac{0.1587}{0.7475}$ **A1**

0.212 **A1**

Question 5 — 3 marks

Answer: $513\ g$

$\frac{500 - \mu}{8} = -1.6449$ $M1$**A1**

$\mu = 513\ g$ **A1**

Question 6 — 3 marks

Answer: $\sigma = 9.65$

$\frac{95 - 80}{\sigma} = 1.5548$ $M1$**A1**

$\sigma = 9.65$ **A1**

Question 7 — 5 marks

Answer: $\mu = 49.9$, $\sigma = 11.8$

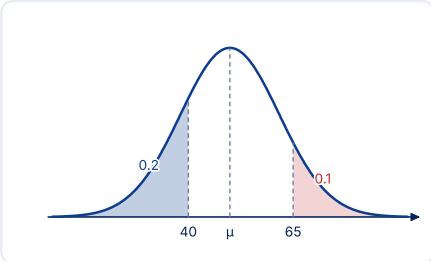
$\frac{40 - \mu}{\sigma} = -0.8416$ **A1**

$\frac{65 - \mu}{\sigma} = 1.2816$ **A1**

attempt to solve **M1**

$\sigma = 11.8$ **A1**

$\mu = 49.9$ **A1**



$P(X < 40) = 0.2$ and $P(X > 65) = 0.1$

Question 8 — 4 marks

Answer: (a) 0.106; (b) 0.628

(a)

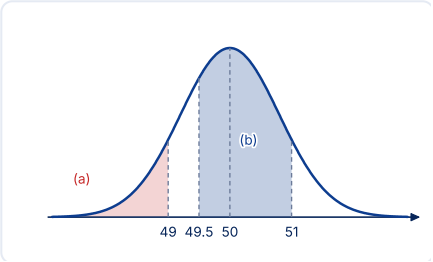
$P(L < 49)$ **M1**

0.106 **A1**

(b)

$P(49.5 < L < 51)$ **M1**

0.628 **A1**



(a) below 49; (b) between 49.5 and 51

Question 9 — 4 marks

Answer: (a) 0.106; (b) 52.8

(a)

$P(X < 1000)$ **M1**

0.106 **A1**

(b)

500×0.1056 **M1**

52.8 **A1**

Question 10 — 5 marks

Answer: (a) 0.0912; (b) 0.211

(a)

$P(H > 180)$ **M1**

0.0912 **A1**

(b)

$B(12,\ 0.0912)$ **M1**

$\binom{12}{2}(0.0912)^2(0.9088)^{10}$ **A1**

0.211 **A1**

Every solution is also on ibmathrevision.com/hlaa/normal-distribution-exam-practice
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