4. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

The distances, m miles, a motorbike travels on a full tank of petrol can be modelled by a normal distribution with mean 170 miles and standard deviation 16 miles.

(a) Find the probability that, on a randomly selected journey, the motorbike could travel at least 190 miles on a full tank of petrol.

(2)

The probability that, on a randomly selected journey, the motorbike could travel at least d miles on a full tank of petrol is 0.9

(b) Find the value of d

(3)

DO NOT WRITE IN THIS AREA

5. The label on a jar of Amy's jam states that the jar contains about 400 grams of jam. For each jar that contains less than 388 grams of jam, Amy will be fined £100. If a jar contains more than 410 grams of jam then Amy makes a loss of £0.30 on that jar.

The weight of jam, A grams, in a jar of Amy's jam has a normal distribution with mean μ grams and standard deviation σ grams. Amy chooses μ and σ so that $P(A < 388) = 0.001$ and $P(A > 410) = 0.0197$

(a) Find the value of μ and the value of σ.

(7)

Amy can sell jars of jam containing between 388 grams and 410 grams for a profit of £0.25

(b) Calculate the expected amount, in £s, that Amy receives for each jar of jam.

(4)

4. The weights of packages delivered to Susie are normally distributed with a mean of 510 grams and a standard deviation of 45 grams.

(a) Find the probability that a randomly selected package delivered to Susie weighs less than 450 grams.

(3)

The heaviest 5% of packages delivered to Susie are delivered by Rav in his van, the others are delivered by Taruni on foot.

(b) Find the weight of the lightest package that Rav would deliver to Susie.

(3)

Susie randomly selects a package from those delivered by Taruni.

(c) Find the probability that this package weighs more than 450 grams.

(4)

On Tuesday there are 5 packages delivered to Susie.

(d) Find the probability that 4 are delivered by Taruni and 1 is delivered by Rav.

(3)

DO NOT WRITE IN THIS AREA DO NO

blank

3. The distance that Jenny throws a javelin is normally distributed with mean 42 m and standard deviation 5 m.

(a) Find the probability that the distance Jenny throws the javelin is less than 40 m.

(3)

Jenny enters a javelin competition. To qualify for the final she has 3 attempts to throw the javelin a distance of more than 40 m. Once she has qualified she does not use any of her remaining attempts.

Given that Jenny qualified for the final and that throws of the javelin are independent,

(b) find the probability that she qualified for the final on her third throw with a distance greater than 45 m.

(5)

DO NOT WRITE IN THIS AREA

7. A machine squeezes apples to extract their juice. The volume of juice, J ml, extracted from 1 kg of apples is modelled by a normal distribution with mean μ and standard deviation σ

Given that $\mu = 500$ and $\sigma = 25$ use standardisation to

(a) (i) show that $P(J > 510) = 0.3446$

(2)

(ii) calculate the value of d such that $P(J > d) = 0.9192$

(3)

Zen randomly selects 5 bags each containing 1 kg of apples and records the volume of juice extracted from each bag of apples.

(b) Calculate the probability that each of the 5 bags of apples produce less than 510 ml of juice.

(2)

Following adjustments to the machine, the volume of juice, R ml, extracted from 1 kg of apples is such that $\mu = 520$ and $\sigma = k$

Given that $P(R < r) = 0.15$ and $P(R > 3r - 800) = 0.005$

(c) find the value of r and the value of k

(7)

Leave blank

5. The random variable X has a normal distribution with mean 10 and standard deviation 6

(a) Find $P(X < 7)$

(3)

(b) Find the value of k such that

$$P(10 - k < X < 10 + k) = 0.60$$

(3)

A single observation x, of X, is to be taken.
A rectangle is drawn on a centimetre grid with vertices having coordinates $(0, 0)$, $(x, 0)$, $(x, x - 3)$ and $(0, x - 3)$

(c) Find the probability that the area of this rectangle is more than $40\,cm^2$

(8)

DO NOT WRITE IN THIS AREA

Leave blank

5. Jia writes a computer program that randomly generates values from a normal distribution.

He sets the mean as 40 and the standard deviation as 2.4

(a) Find the probability that a particular value generated by the computer program is less than 37

(3)

Jia changes the mean to m but leaves the standard deviation as 2.4

The computer program then randomly generates 2 independent values from this normal distribution.

The probability that both of these values are greater than 32 is 0.16

(b) Find the value of m, giving your answer to 2 decimal places.

(4)

Jia now changes the mean to 4 and the standard deviation to 8

The computer program then randomly generates 5 independent values from this normal distribution.

(c) Find the probability that at least one of these values is negative.

(4)

DO NOT WRITE IN THIS AREA