

**3. Read the passage in the resource folder carefully, before answering the questions which follow.**

- (a) Explain briefly how the three factors of weight (mass), surface area, and thickness affect the cooking time of the turkey. Include in your answers scientific reasons for these variations (see lines 42-47). [6]

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- (b) An important factor is missing from the explanation of specific heat capacity. Modify the statement to make it accurate (lines 21-22). [1]

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- (c) The smaller (4.5 kg) turkey has a width of 22 cm. Calculate the width of the larger (9.0 kg) turkey (lines 36-40). [1]

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- (d) The larger turkey (9.0 kg) has a surface area of  $0.46 \text{ m}^2$ . Calculate the surface area of the smaller (4.5 kg) turkey (lines 36-40). [1]

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(e) The turkeys are considered to be cooked when their average temperature has risen  $90^{\circ}\text{C}$ .

- (i) How much thermal energy does this require for the  $9.0\text{ kg}$  turkey? (specific heat capacity of turkey =  $3200\text{ J kg}^{-1}^{\circ}\text{C}^{-1}$ ). [2]

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- (ii) The electrical power supplied to the cooking oven was  $2200\text{ W}$ . If all this energy was transferred as thermal energy to the turkey, how long should the  $9.0\text{ kg}$  turkey have taken to cook? [2]

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- (iii) Why is there such a large difference between the answer to (e) and the time given in the passage? [2]

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(f) The equation for heat conduction is

$$\frac{\Delta Q}{\Delta t} = -kA \frac{\Delta \theta}{\Delta x}$$

and, to an approximation, can be applied to the cooking turkey.

- (i) You may assume that the temperature difference ( $\Delta\theta$ ) for the cooking turkey remains at a constant  $140^{\circ}\text{C}$  and that this temperature gradient occurs over **half the width of the turkey**. What is the rate of heat transfer for the  $9\text{ kg}$  turkey? (Thermal conductivity for the turkey =  $0.6\text{ W m}^{-1}^{\circ}\text{C}^{-1}$ .) [3]

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- (ii) Assuming that this rate of heat transfer to the turkey remains constant over the cooking time and using your result of (e)(i), calculate the cooking time for the  $9\text{ kg}$  turkey in hours. [2]

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