

1 A pathologist can use a number of methods to estimate the time of death of a body found at a crime scene.

(a) The pathologist will measure the body temperature and the temperature of the surroundings.

Explain why it is necessary to take these two measurements as soon as possible.

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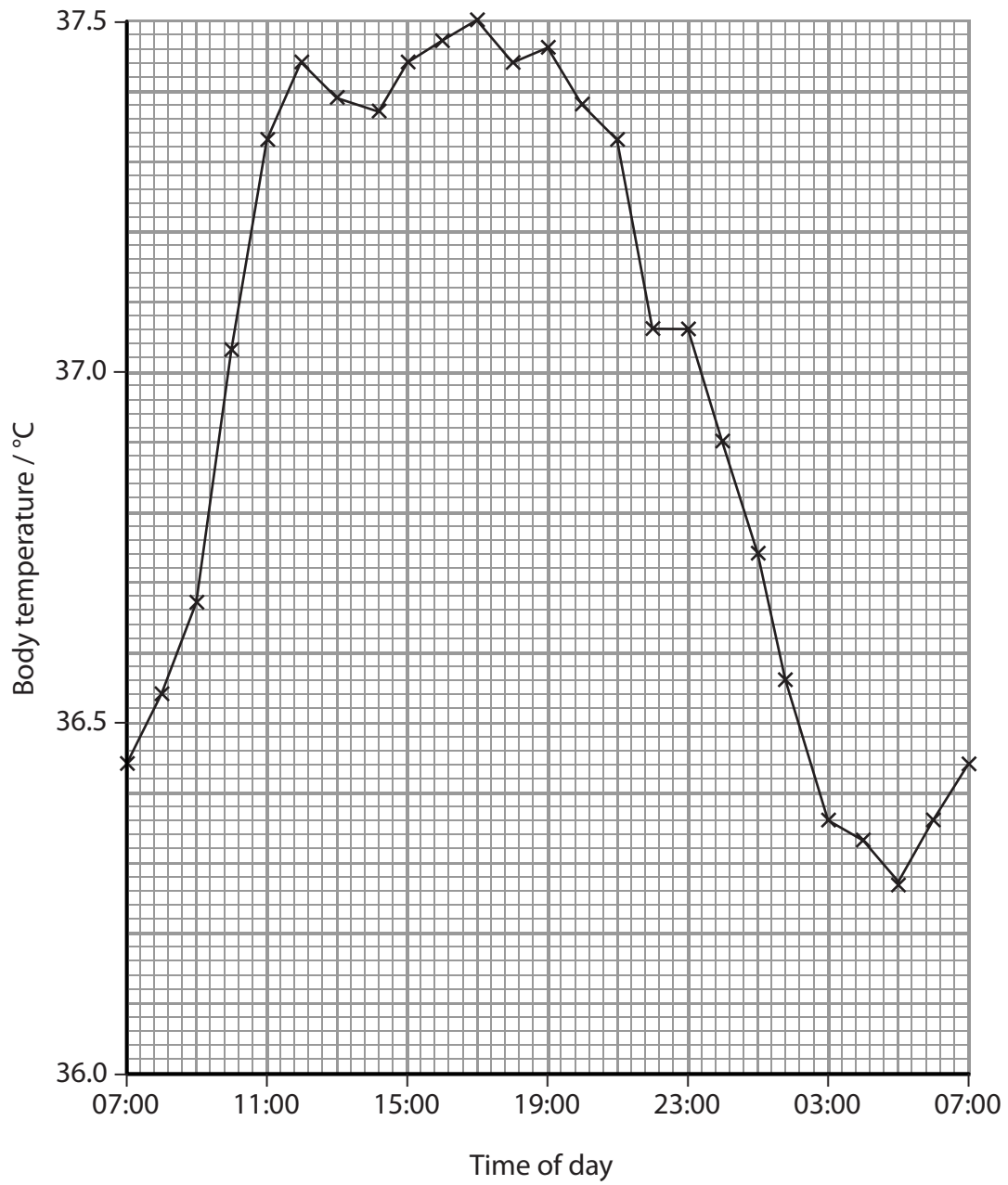
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(b) The graph below shows variation in the body temperature of a living person over a period of 24 hours.



(i) Using the information in the graph, calculate the maximum change in body temperature over this period of 24 hours.

(2)

..... °C

(ii) Suggest how a pathologist could use the information in this graph to estimate the time of death of a body at a crime scene.

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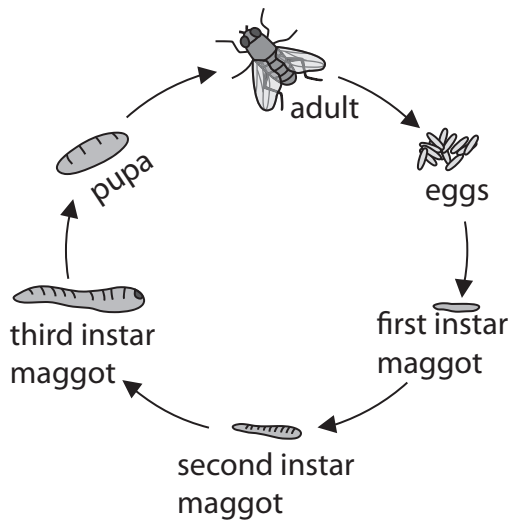
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*(c) A pathologist can also use forensic entomology to estimate the time of death of a body.
The diagram below shows the life cycle of a fly.



Describe an investigation that could be carried out to study the effect of temperature on the time taken for the first instar maggot to become a pupa.

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(Total for Question 1 = 12 marks)

2 Frogs are ectothermic animals. This means that their body temperature will vary as the environmental temperature varies.

(a) Explain why body temperature affects the rate of development of animals.

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(b) Several species of the frog genus, *Rana*, can be found in North America. Many of these species inhabit areas within a range of latitudes from the colder north to the warmer south.

The table below shows data for four of these species, *R. clamitans*, *R. palustris*, *R. pipiens* and *R. sylvatica*.

Species	Body temperature of frog / °C			
	Lower lethal, below which frog dies	Minimum to start development	Maximum to complete development	Upper lethal, above which frog dies
<i>R. clamita</i>	10.0	11.0	35.0	37.0
<i>R. palustr</i>	5.0	7.0	30.0	31.0
<i>R. pipie</i>	3.0	6.0	28.0	30.0
<i>R. sy atica</i>	0.0	2.0	24.0	25.0

Using the information, suggest why the lower and upper lethal temperatures limit the range of latitudes inhabited by each species of frog.

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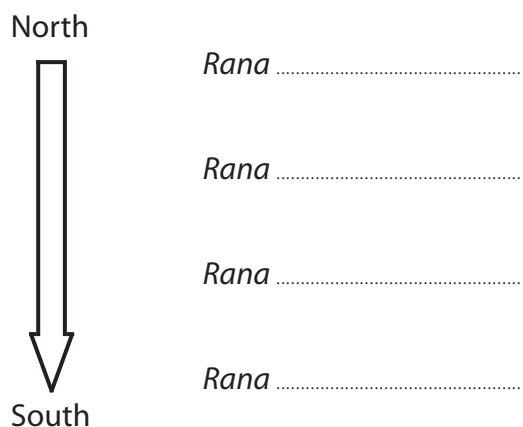
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(c) Complete the species names in the diagram below to show the most likely distribution of *Rana* from north to south.

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(d) Populations of the different species overlap on the boundaries of each latitude range.

Suggest why interbreeding does not take place between these populations.

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(e) Suggest how global warming may affect the distribution of these species of *Rana* in North America.

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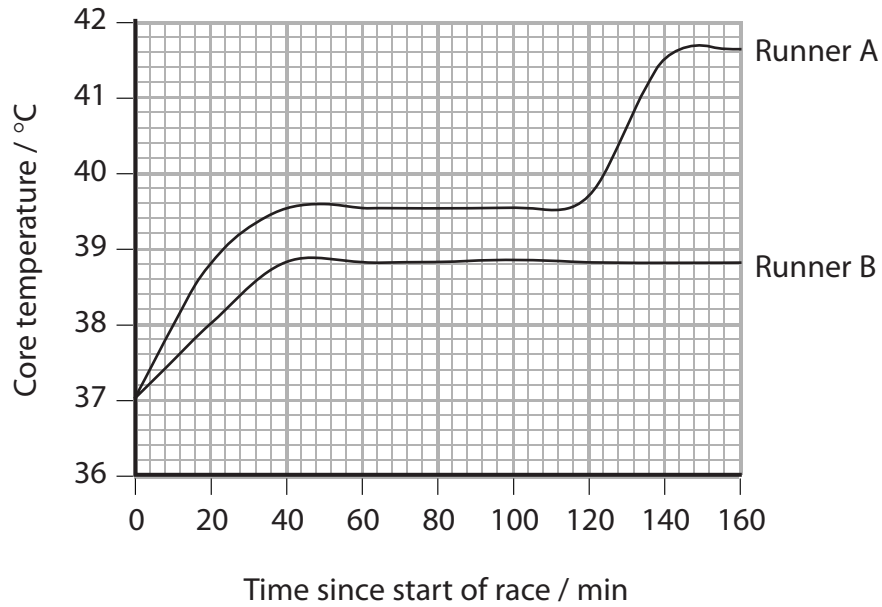
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(Total for Question 2 = 13 marks)

3 Marathon runners can have difficulty with thermoregulation over the course of a 26 mile race, particularly on a hot day. Two marathon runners, A and B, had their core temperatures recorded during a race.

The graph below shows the core temperatures recorded during the race.



(a) Suggest an explanation for the change in core temperatures of both runners in the first 30 minutes of the race.

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(b) Suggest an explanation for the constant core temperatures of both runners between 60 and 100 minutes of this race.

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(c) During this race, runner A lost 3.02 kg of water and runner B lost 2.43 kg of water.

Using the information in the question and your own knowledge, suggest reasons for the change in core temperature of runner A after 120 minutes.

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(Total for Question 3 = 9 marks)