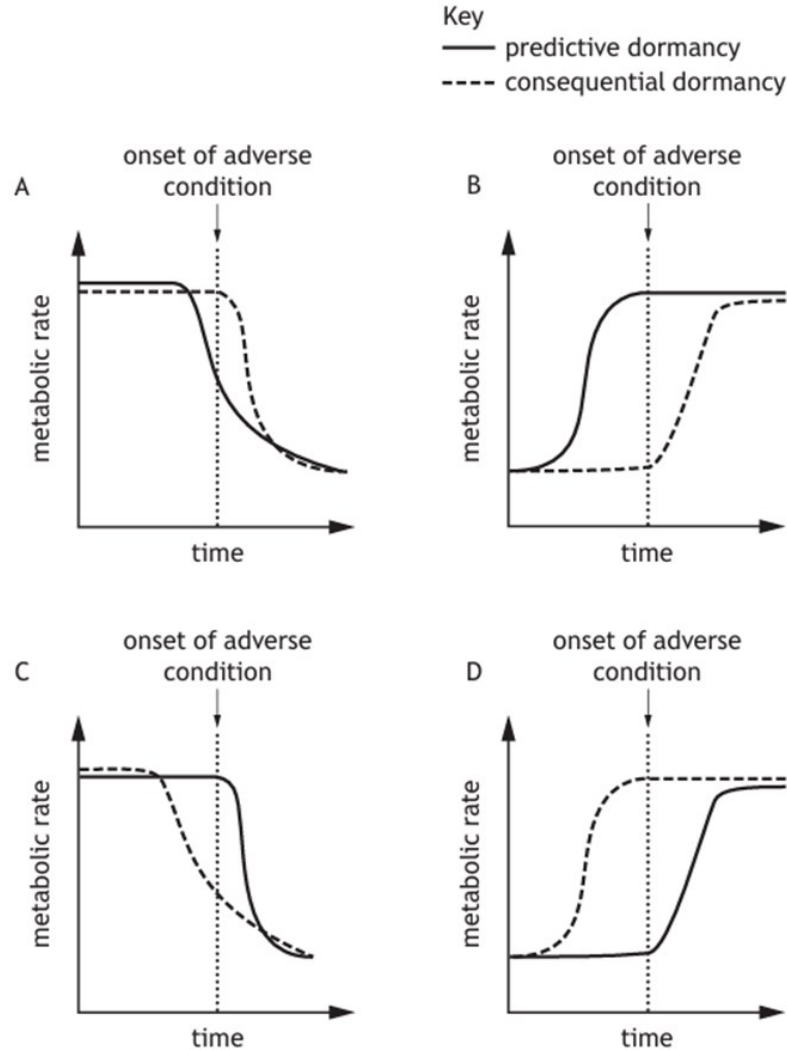


Surviving & Avoiding Adverse conditions Past Papers

1. Dormancy in organisms can be predictive or consequential.

Which of the following graphs shows the changes in metabolic rate in organisms entering predictive and consequential dormancy?



- 2.

Some species of lungfish live in African lakes. If there is a drought, lakes may dry out but the lungfish can survive by burying themselves in the remaining mud and becoming dormant.

Which line in the table correctly identifies the description and the type of dormancy displayed by the lungfish in these circumstances?

	<i>Description of dormancy</i>	<i>Type of dormancy</i>
A	predictive	aestivation
B	consequential	aestivation
C	predictive	hibernation
D	consequential	hibernation

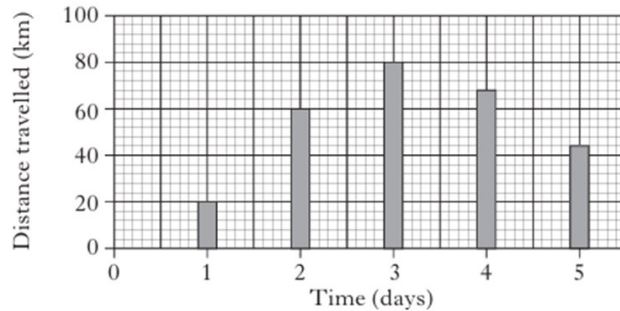
3. Which of the following descriptions relates to migration?

- A It allows animals to avoid adverse conditions.
- B It allows animals to survive adverse conditions.
- C It only involves learned behaviour.
- D It only involves innate behaviour.

Surviving & Avoiding Adverse conditions Past Papers

4. The buff-breasted pipit is a bird which migrates into parts of the USA each spring.

The chart below shows the average distance travelled by the birds in the first five days of their migration.



The greatest distance travelled by the pipit is on days

- A 1 and 2
 B 2 and 3
 C 3 and 4
 D 4 and 5.
5. The giant bullfrog of South Africa lives in a habitat in which hot and dry conditions can occur at any time of year. To survive these conditions, the frogs respond by becoming dormant.
- Which of the following descriptions applies to this type of dormancy?
- A Predictive aestivation
 B Predictive hibernation
 C Consequential aestivation
 D Consequential hibernation

6. Which of the statements describes a behaviour used to avoid adverse conditions?

- A Ruby throated hummingbirds enter a state of torpor every night.
 B Humpback whales swim from Alaska to Hawaii prior to the onset of winter.
 C European hedgehogs reduce their metabolic rate as a result of low temperatures.
 D Mugger crocodiles become dormant due to drought conditions.

7. The bar-tailed godwit is a species of bird that migrates from Alaska to New Zealand each autumn. A satellite tracker was used to study one bar-tailed godwit on this migration.

The bird completed the 11 000 km journey in 9 days.

The average speed of the bar-tailed godwit during migration was

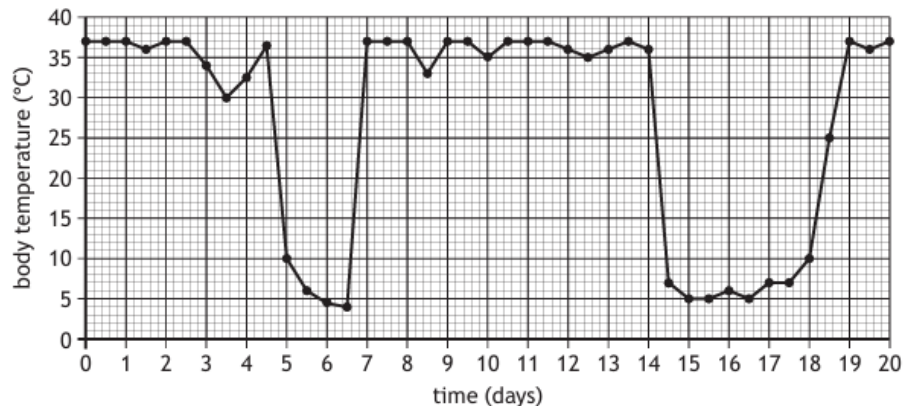
- A 0.02 km/hr
 B 50.93 km/hr
 C 458.33 km/hr
 D 1222.22 km/hr

Surviving & Avoiding Adverse conditions Past Papers

1. Arctic ground squirrels are found in Alaska and survive low winter temperatures by becoming dormant for short periods of time.

To study dormancy in an Arctic ground squirrel, its body temperature was measured over a period of 20 days in winter.

The results are shown in the graph.



- (i) Calculate the total time that the Arctic ground squirrel's body temperature was 10 °C or below.

Space for calculation

1

_____ days

- (ii) Apart from decreasing body temperature, state another change that may be observed in an Arctic ground squirrel during dormancy.

1

- (b) The Alaskan brown bear hibernates during winter. The average monthly air temperatures in Alaska are shown in the table.

Month	Average air temperature (°C)
January	−28
February	−29
March	−28
April	−21
May	−9
June	−1
July	2
August	2
September	−2
October	−11
November	−20
December	−25

- (i) Calculate the average monthly decrease in air temperature over the four-month period from the beginning of August until the end of November.

Space for calculation

1

_____ °C per month

- (ii) Alaskan brown bears hibernate between August and April. Use information in the table to identify the type of dormancy.

Give a reason for your answer.

2

Type of dormancy _____

Reason _____

- (iii) State one advantage of hibernation to Alaskan brown bears.

1

Surviving & Avoiding Adverse conditions Past Papers

2.

Freshwater crocodiles (*Crocodylus johnsoni*) in Northern Australia aestivate for up to three months. A study was carried out to investigate aestivation in freshwater crocodiles. The body temperature, metabolic rate, and air temperature were recorded.

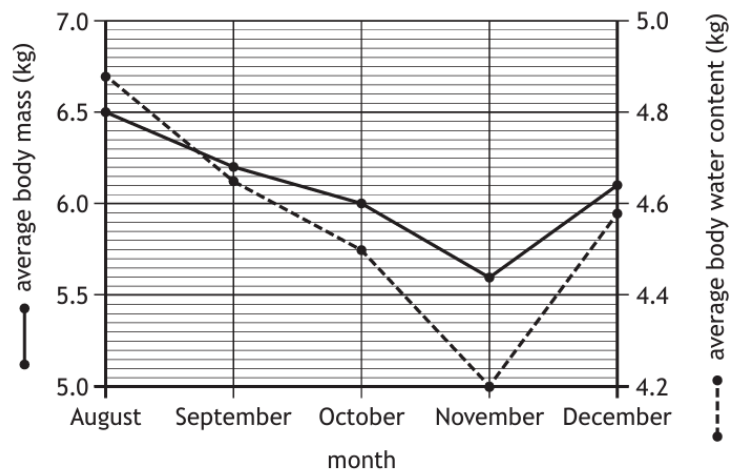
The results are shown in the table.

Month	Average body temperature (°C)	Average metabolic rate (kJ/kg/day)	Average air temperature (°C)
August	25.9	36.0	26.2
September	27.9	26.1	28.0
October	27.8	26.5	27.5
November	28.9	25.7	29.5
December	28.7	36.7	28.9

- (i) Using information from the table, identify the three-month period when the crocodiles were aestivating.

1

- (b) The graph shows the average body mass and the average body water content of the crocodiles between August and December.



- (c) Using information from the table and the graph:

- (i) calculate the average energy consumption per day of a crocodile in October.

1

Space for calculation

_____ kJ/day

- (ii) state the average metabolic rate when the average body mass was 5.6 kg.

1

_____ kJ/kg/day

Surviving & Avoiding Adverse conditions Past Papers

3. Djungarian hamsters (*Phodopus sungorus*) are small mammals with high metabolic rates. Under certain conditions they will enter torpor.

An experiment was carried out to investigate the effect of daily food intake on torpor frequency. Four groups of six hamsters were fed different masses of food each day and the number of times they entered torpor in one week was recorded.

The results are shown in the table.

Group	Mass of food eaten each day (g)	Average torpor frequency (number of times entering torpor in the week)
1	2.5	42
2	3.0	25
3	3.5	15
4	4.0	7

- (a) State an advantage to the hamsters of entering torpor. 1

- (b) Suggest a measurement that could have been taken to determine whether the hamsters had entered torpor. 1

- (c) The average time spent in each period of torpor was 120 minutes.
Calculate the average time spent in torpor **per day** by a hamster with a daily food intake of 2.5 g. 1

Space for calculation

_____ minutes

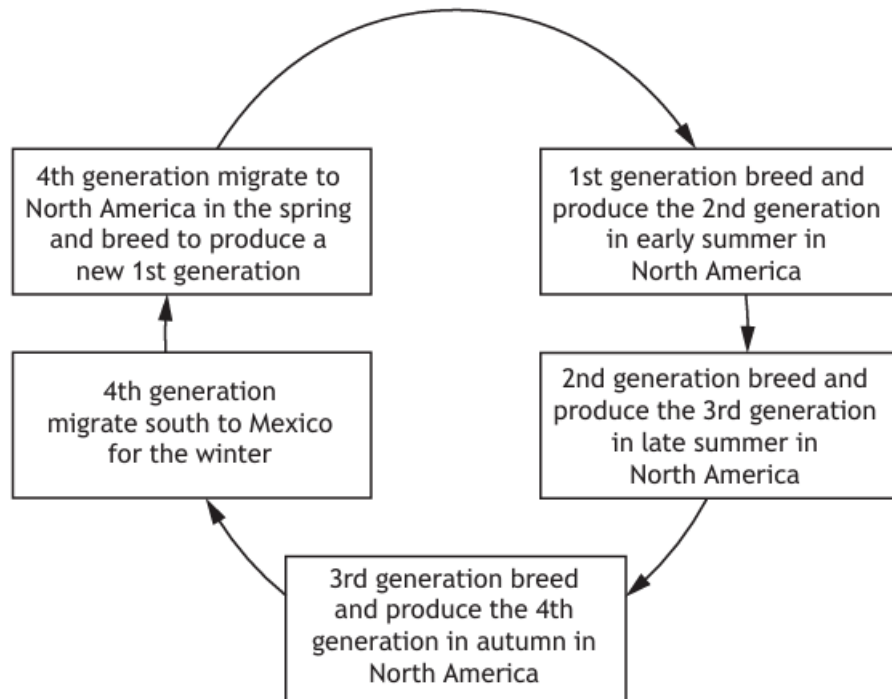
- (d) State how the design of the experiment ensured that the results were reliable. 1

- (e) Suggest a factor, other than daily food intake, which could affect torpor frequency. 1

- (f) Daily torpor is a way in which animals survive adverse conditions.
Give **one** way in which animals avoid adverse conditions. 1

Surviving & Avoiding Adverse conditions Past Papers

4. The diagram shows information on the breeding and migration of Monarch butterflies (*Danaus plexippus*). Each generation dies after laying eggs.



- (b) The migratory behaviour of the Monarch butterfly from North America to Mexico is innate.

Use the information given to justify this statement.

1

- (c) Some species of hummingbird also migrate between North America and Mexico. They have high metabolic rates which they reduce while resting each night during the migration period.

Name this reduction in metabolic rate.

1

- (a) State one advantage and one disadvantage to the Monarch butterfly of migration to Mexico.

2

Advantage _____

Disadvantage _____

Surviving & Avoiding Adverse conditions Past Papers

5. An investigation was carried out to find out how the breathing rate of a group of desert tortoises varied over a year.

The results are shown in the table.

Month	Average breathing rate (breaths/minute)
January	2.8
February	2.9
March	14.0
April	20.2
May	19.6
June	20.4
July	19.8
August	19.5
September	20.4
October	16.8
November	3.2
December	2.7

- (a) (i) Express, as a simple whole number ratio, the breathing rate in the months of January, March and October.

Space for calculation

_____ : _____ : _____
January March October

- (ii) Use evidence from the table to identify the months when desert tortoises were hibernating.

1

- (b) If there is a drought, desert tortoises survive by decreasing their heart rate and breathing rate.

Name this response and explain why it is consequential.

2

Name _____

Explanation _____

- (c) Sugar gliders are small mammals that live in Australia. Their high metabolic rates are reduced each day.

- (i) Give the term used for this type of behaviour.

1

- (ii) State the advantage to sugar gliders of reducing their metabolic rate each day.

1

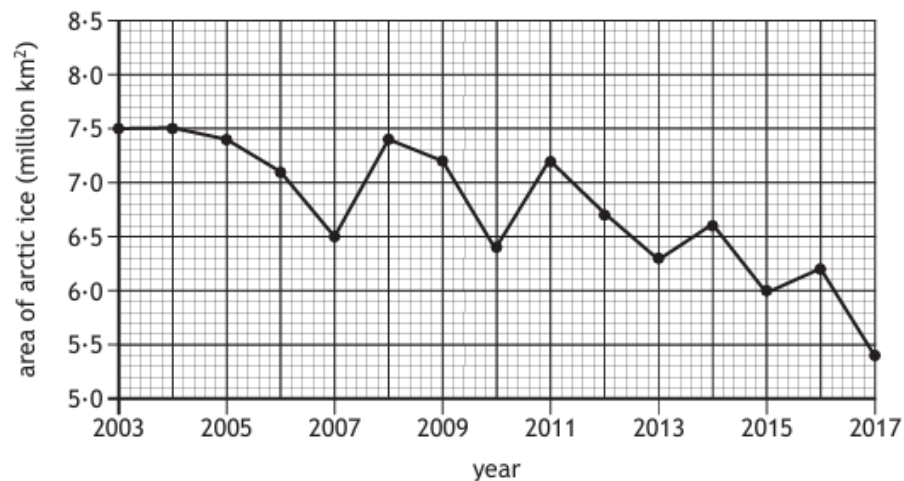
1

Surviving & Avoiding Adverse conditions Past Papers

6. Polar bears (*Ursus maritimus*) live in arctic regions and feed on seals resting on the ice. Some polar bears hibernate to survive the winter.

(a) Explain how hibernation helps polar bears survive the winter.

(b) The graph shows how the area of arctic ice has changed between 2003 and 2017.



- (i) Calculate the area of arctic ice in 2017 as a percentage of the area in 2003.

Space for calculation

_____ %

- (ii) The population of polar bears is likely to decrease if the overall trend in the graph continues.

Suggest a reason for this.

- (c) Other than hibernation, name one way that animals survive adverse conditions.

1

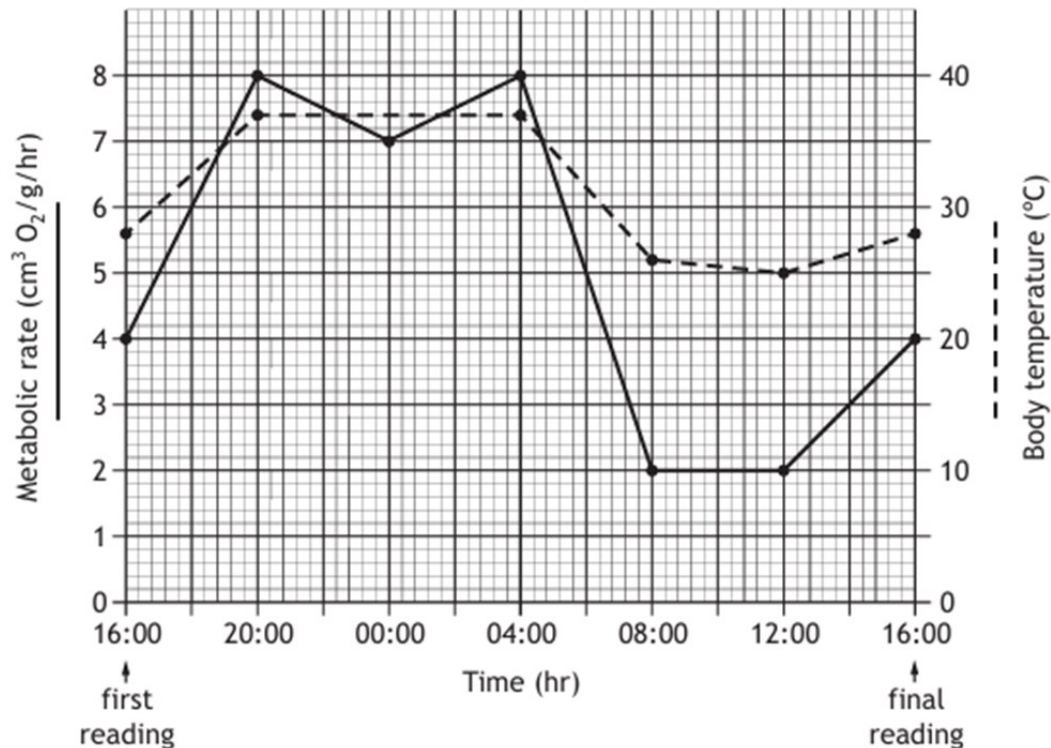
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1

Surviving & Avoiding Adverse conditions Past Papers

7. The northern blossom bat *Macroglossus minimus* is an Asian species which has a high metabolic rate and a daily rhythm of torpor.

The metabolic rates and body temperatures of a group of these bats were recorded every four hours over a 24 hour cycle and the results are shown on the graph below.



- (b) Tick (✓) **one** box to identify the period when the bats were in full torpor and justify your answer.

1600 – 2000

☐

2000 – 0000

☐

0400 – 0800

☐

0800 – 1200

☐

Justification _____

- (c) Give **one** benefit to the bats of their daily torpor.

- (d) Blossom bats are nocturnal.

Give **one other** behavioural adaptation of animals with high metabolic rates to allow survival in adverse conditions.

- (a) Calculate the oxygen consumption of a 16 g bat at 00:00 hours.

Space for calculation

_____ cm³ O₂ per hr

Surviving & Avoiding Adverse conditions Past Papers

8. (a) Marmots are mammals which hibernate below ground in winter.

In an investigation into metabolic rate, the oxygen consumption of a 2.5 kilogram marmot was measured before the start and over the first four days of its hibernation.

The results are shown in the table below.

Day	Oxygen consumption (cm ³ per gram of body mass per hour)
(before start of hibernation period)	1.8
1	1.4
2	0.3
3	0.2
4	0.2

- (i) Calculate the **total** volume of oxygen consumed by the marmot on Day 4.

Space for calculation

_____ cm³ oxygen **1**

- (ii) Explain how hibernation helps the marmot survive the adverse conditions of winter.

 _____ **1**

- (b) Some species of small mammal with high metabolic rates enter a state of reduced activity each day to survive adverse conditions.

Give the term used to describe this state.

_____ **1**

- (c) Many species of bird avoid metabolic adversity by relocating to a more suitable environment.

- (i) Name this type of behaviour.

_____ **1**

- (ii) Specialised techniques are used to study long-distance bird movements.

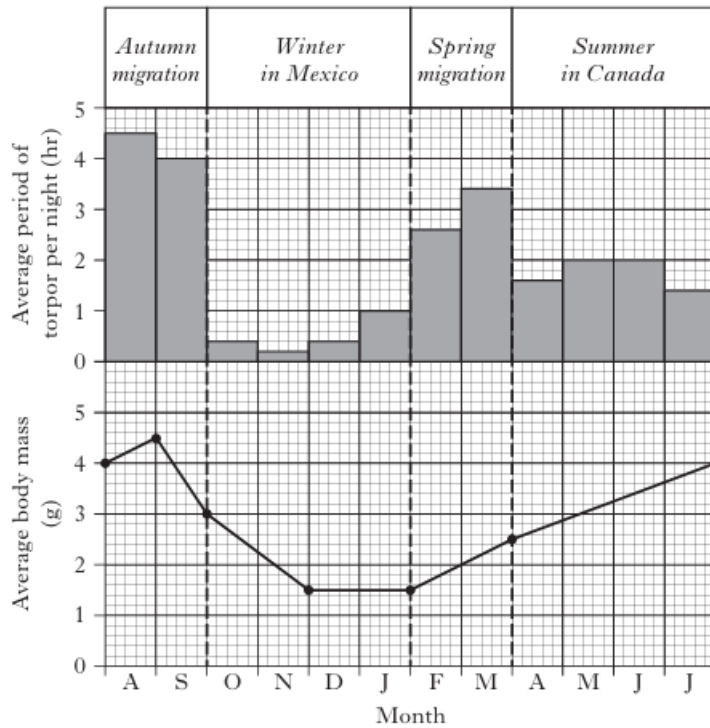
Describe **one** such technique.

Surviving & Avoiding Adverse conditions Past Papers

9. Rufous hummingbirds migrate thousands of kilometres each year between their summer breeding areas in Canada and their wintering areas in Mexico.

They feed on nectar throughout the year and save energy at night by entering a temporary state known as torpor in which body temperature and respiration rate are greatly reduced.

The **chart** below shows the average body mass of the hummingbirds and the average number of hours per night spent in torpor throughout the year.



- a) Describe a technique which could be used to track species such as the rufous hummingbird which undertake long distance migration.

- b) (i) Suggest why the increased time spent in torpor during migration is an advantage to the birds.

- (ii) Suggest **one** reason for the increase in body mass of the birds during the summer in Canada.

- (iii) Calculate the average period of torpor per month throughout the winter in Mexico.

Space for calculation

_____ hours per night 1

- (c) The **table** below shows how the average oxygen consumption of the birds at rest is affected by their body temperature.

Body temperature	Average oxygen consumption at rest (cm ³ per gram of body mass per hour)
Normal	15.0
Lowered during torpor	2.0

Using information from the **chart** and the **table**, calculate the average volume of oxygen consumed per hour by a hummingbird at the end of September at normal body temperature.

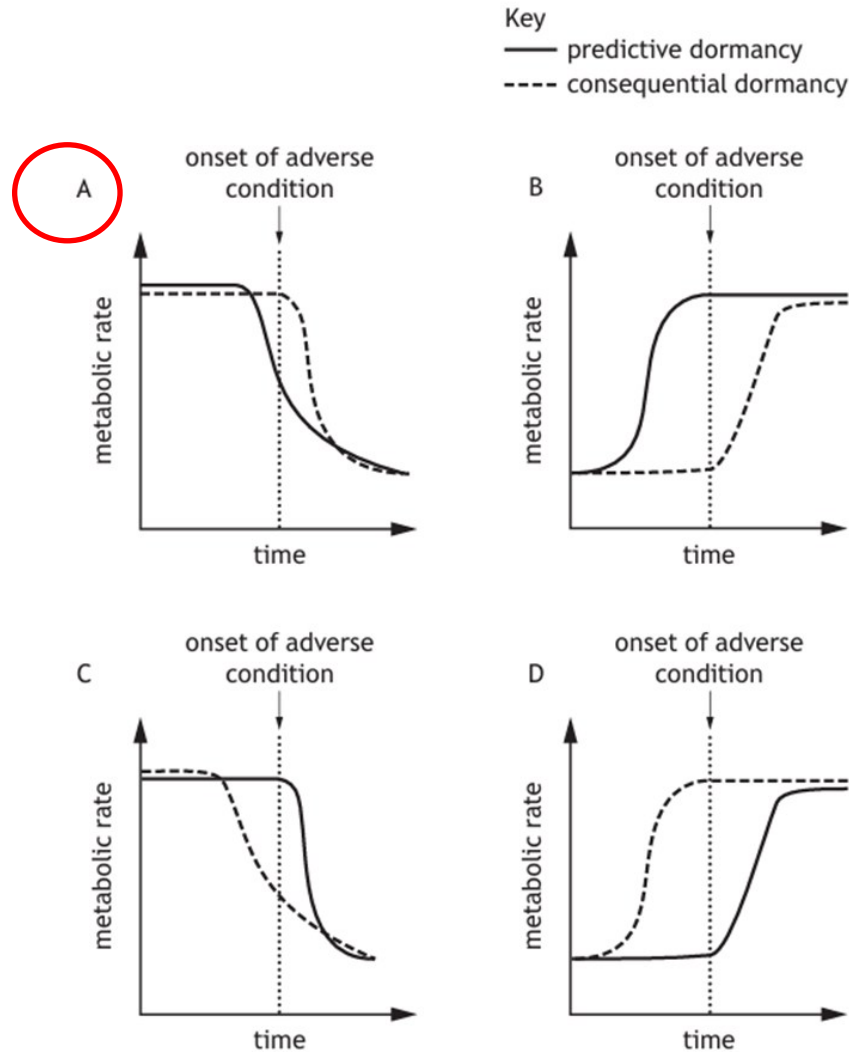
Space for calculation

_____ cm³ 1

Surviving & Avoiding Adverse conditions Past Papers

1. Dormancy in organisms can be predictive or consequential.

Which of the following graphs shows the changes in metabolic rate in organisms entering predictive and consequential dormancy?



2. Some species of lungfish live in African lakes. If there is a drought, lakes may dry out but the lungfish can survive by burying themselves in the remaining mud and becoming dormant.

Which line in the table correctly identifies the description and the type of dormancy displayed by the lungfish in these circumstances?

	<i>Description of dormancy</i>	<i>Type of dormancy</i>
A	predictive	aestivation
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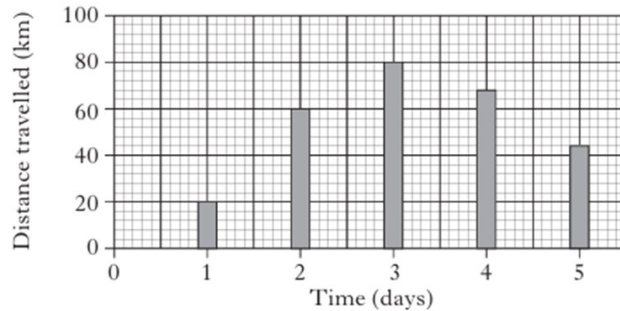
3. Which of the following descriptions relates to migration?

- A It allows animals to avoid adverse conditions.
 B It allows animals to survive adverse conditions.
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Surviving & Avoiding Adverse conditions Past Papers

4. The buff-breasted pipit is a bird which migrates into parts of the USA each spring.

The chart below shows the average distance travelled by the birds in the first five days of their migration.



The greatest distance travelled by the pipit is on days

- A 1 and 2
- B 2 and 3
- ☒ C 3 and 4
- D 4 and 5.

5. The giant bullfrog of South Africa lives in a habitat in which hot and dry conditions can occur at any time of year. To survive these conditions, the frogs respond by becoming dormant.

Which of the following descriptions applies to this type of dormancy?

- A Predictive aestivation
- B Predictive hibernation
- ☒ C Consequential aestivation
- D Consequential hibernation

6. Which of the statements describes a behaviour used to avoid adverse conditions?

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7. The bar-tailed godwit is a species of bird that migrates from Alaska to New Zealand each autumn. A satellite tracker was used to study one bar-tailed godwit on this migration.

The bird completed the 11 000 km journey in 9 days.

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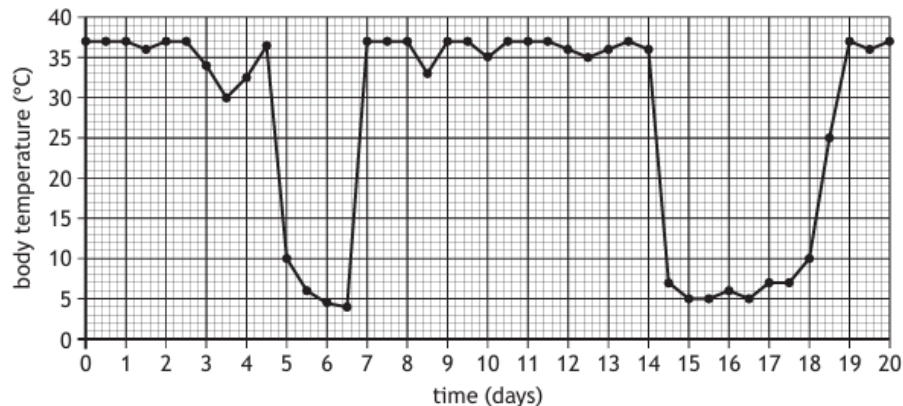
- A 0.02 km/hr
- ☒ B 50.93 km/hr
- C 458.33 km/hr
- D 1222.22 km/hr

Surviving & Avoiding Adverse conditions Past Papers

1. (a) Arctic ground squirrels are found in Alaska and survive low winter temperatures by becoming dormant for short periods of time.

To study dormancy in an Arctic ground squirrel, its body temperature was measured over a period of 20 days in winter.

The results are shown in the graph.



- (i) Calculate the total time that the Arctic ground squirrel's body temperature was 10 °C or below.

Space for calculation

1

Any value 5 to 5.2

_____ days

- (ii) Apart from decreasing body temperature, state another change that may be observed in an Arctic ground squirrel during dormancy.

1

Decreased breathing rate OR metabolic rate

- (b) The Alaskan brown bear hibernates during winter. The average monthly air temperatures in Alaska are shown in the table.

Month	Average air temperature (°C)
January	−28
February	−29
March	−28
April	−21
May	−9
June	−1
July	2
August	2
September	−2
October	−11
November	−20
December	−25

- (i) Calculate the average monthly decrease in air temperature over the four-month period from the beginning of August until the end of November.

1

Space for calculation

5.5 OR 6

_____ °C per month

- (ii) Alaskan brown bears hibernate between August and April. Use information in the table to identify the type of dormancy.

Give a reason for your answer.

2

Type of dormancy Predictive

Reason Began before onset of adverse conditions (drop in air temp)

- (iii) State one advantage of hibernation to Alaskan brown bears.

1

Saves energy

Surviving & Avoiding Adverse conditions Past Papers

2. Freshwater crocodiles (*Crocodylus johnsoni*) in Northern Australia aestivate for up to three months. A study was carried out to investigate aestivation in freshwater crocodiles. The body temperature, metabolic rate, and air temperature were recorded.

The results are shown in the table.

Month	Average body temperature (°C)	Average metabolic rate (kJ/kg/day)	Average air temperature (°C)
August	25.9	36.0	26.2
September	27.9	26.1	28.0
October	27.8	26.5	27.5
November	28.9	25.7	29.5
December	28.7	36.7	28.9

- (c) Using information from the table and the graph:

- (i) calculate the average energy consumption per day of a crocodile in October.

1

Space for calculation

159 kJ/day

- (ii) state the average metabolic rate when the average body mass was 5.6 kg.

1

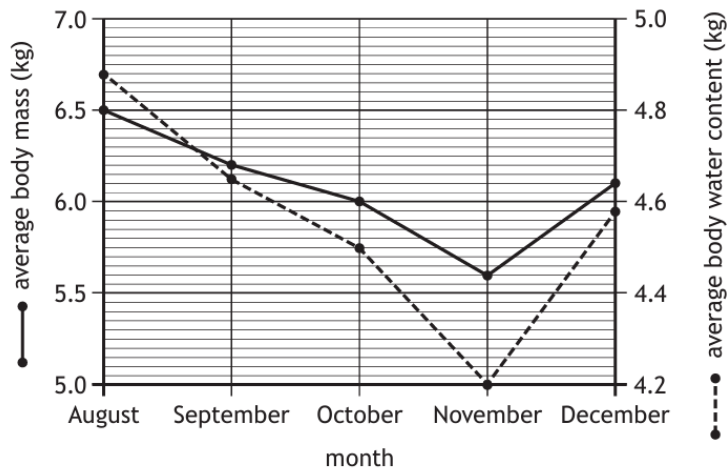
25.7 kJ/kg/day

- (i) Using information from the table, identify the three-month period when the crocodiles were aestivating.

1

September, October and November

- (b) The graph shows the average body mass and the average body water content of the crocodiles between August and December.



Surviving & Avoiding Adverse conditions Past Papers

3. Djungarian hamsters (*Phodopus sungorus*) are small mammals with high metabolic rates. Under certain conditions they will enter torpor.

An experiment was carried out to investigate the effect of daily food intake on torpor frequency. Four groups of six hamsters were fed different masses of food each day and the number of times they entered torpor in one week was recorded.

The results are shown in the table.

Group	Mass of food eaten each day (g)	Average torpor frequency (number of times entering torpor in the week)
1	2.5	42
2	3.0	25
3	3.5	15
4	4.0	7

- (a) State an advantage to the hamsters of entering torpor. 1

Saves energy

- (b) Suggest a measurement that could have been taken to determine whether the hamsters had entered torpor. 1

Lowered heart rate/breathing rate/body temperature

- (c) The average time spent in each period of torpor was 120 minutes.
Calculate the average time spent in torpor **per day** by a hamster with a daily food intake of 2.5 g. 1

Space for calculation

720 minutes

- (d) State how the design of the experiment ensured that the results were reliable. 1

6 hamsters in each group

- (e) Suggest a factor, other than daily food intake, which could affect torpor frequency. 1

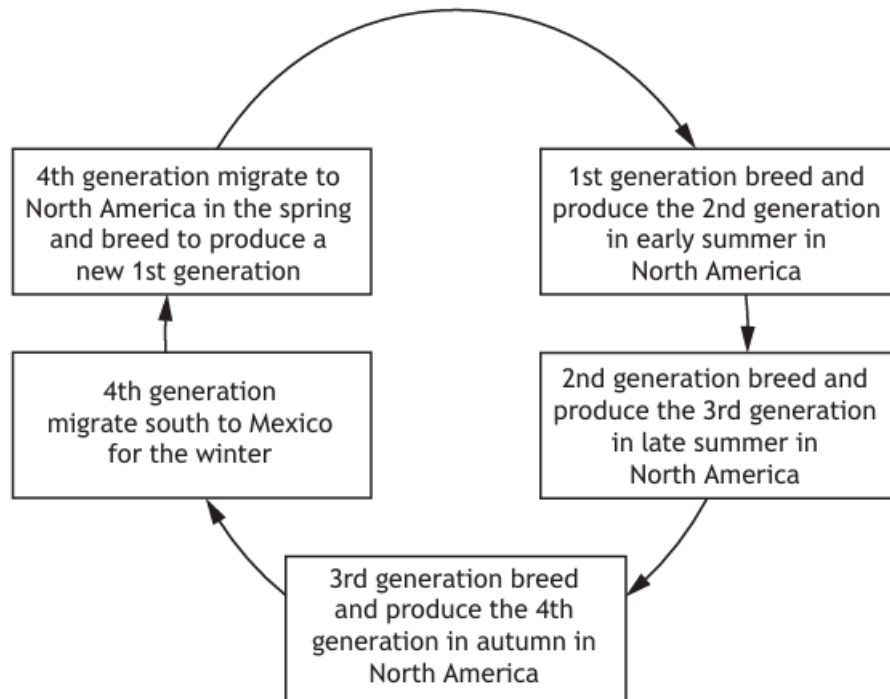
Age/species/Temperature/body mass

- (f) Daily torpor is a way in which animals survive adverse conditions.
Give **one** way in which animals avoid adverse conditions. 1

migration

Surviving & Avoiding Adverse conditions Past Papers

4. The diagram shows information on the breeding and migration of Monarch butterflies (*Danaus plexippus*). Each generation dies after laying eggs.



- (b) The migratory behaviour of the Monarch butterfly from North America to Mexico is innate.

Use the information given to justify this statement.

1

Only 4th generation migrate so don't learn from parents.

- (c) Some species of hummingbird also migrate between North America and Mexico. They have high metabolic rates which they reduce while resting each night during the migration period.

Name this reduction in metabolic rate.

1

Daily torpor

- (a) State one advantage and one disadvantage to the Monarch butterfly of migration to Mexico.

2

Advantage Avoids metabolic adversity/adverse conditions

Disadvantage Uses energy

Surviving & Avoiding Adverse conditions Past Papers

5. An investigation was carried out to find out how the breathing rate of a group of desert tortoises varied over a year.

The results are shown in the table.

Month	Average breathing rate (breaths/minute)
January	2.8
February	2.9
March	14.0
April	20.2
May	19.6
June	20.4
July	19.8
August	19.5
September	20.4
October	16.8
November	3.2
December	2.7

- (a) (i) Express, as a simple whole number ratio, the breathing rate in the months of January, March and October.

Space for calculation

1 5 6
 _____ : _____ : _____
 January March October

- (ii) Use evidence from the table to identify the months when desert tortoises were hibernating.

1

November to February

- (b) If there is a drought, desert tortoises survive by decreasing their heart rate and breathing rate.

Name this response and explain why it is consequential.

2

Name Aestivation

Explanation Happens after onset of adverse conditions

- (c) Sugar gliders are small mammals that live in Australia. Their high metabolic rates are reduced each day.

- (i) Give the term used for this type of behaviour.

1

Daily torpor

- (ii) State the advantage to sugar gliders of reducing their metabolic rate each day.

1

Saves energy

1

Surviving & Avoiding Adverse conditions Past Papers

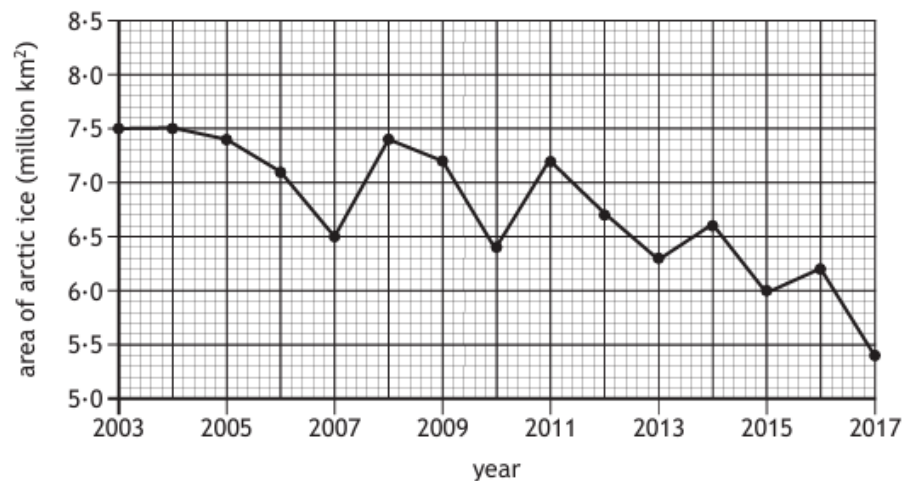
6. Polar bears (*Ursus maritimus*) live in arctic regions and feed on seals resting on the ice. Some polar bears hibernate to survive the winter.

(a) Explain how hibernation helps polar bears survive the winter.

Lowers heart rate/breathing rate/body temperature

which saves energy

(b) The graph shows how the area of arctic ice has changed between 2003 and 2017.



(i) Calculate the area of arctic ice in 2017 as a percentage of the area in 2003.

Space for calculation

72 %

(ii) The population of polar bears is likely to decrease if the overall trend in the graph continues.

Suggest a reason for this.

Less food/seals

(c) Other than hibernation, name one way that animals survive adverse conditions.

Aestivation OR Daily torpor

1

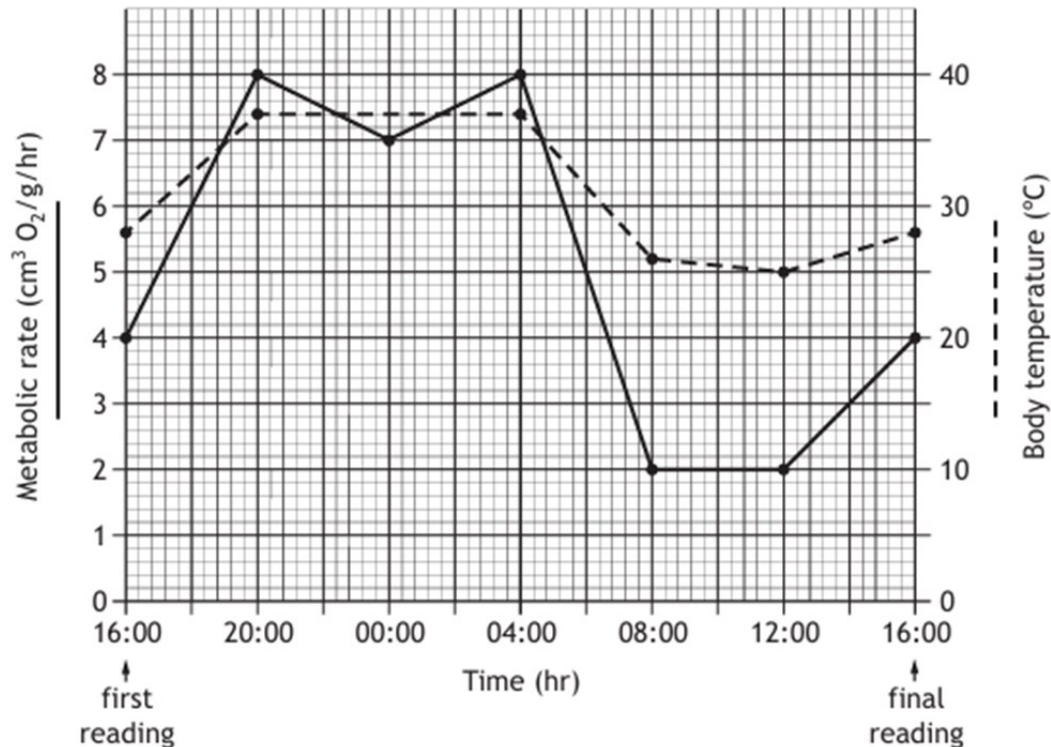
1

1

Surviving & Avoiding Adverse conditions Past Papers

7. The northern blossom bat *Macroglossus minimus* is an Asian species which has a high metabolic rate and a daily rhythm of torpor.

The metabolic rates and body temperatures of a group of these bats were recorded every four hours over a 24 hour cycle and the results are shown on the graph below.



- (b) Tick (✓) **one** box to identify the period when the bats were in full torpor and justify your answer.

1600 – 2000

☐

2000 – 0000

☐

0400 – 0800

☐

0800 – 1200

☒

Justification Time of lowest metabolic rate

- (c) Give **one** benefit to the bats of their daily torpor.

Saves energy

- (d) Blossom bats are nocturnal.

Give **one other** behavioural adaptation of animals with high metabolic rates to allow survival in adverse conditions.

Daily torpor

- (a) Calculate the oxygen consumption of a 16 g bat at 00:00 hours.

Space for calculation

112

_____ cm³ O₂ per hr

Surviving & Avoiding Adverse conditions Past Papers

8. (a) Marmots are mammals which hibernate below ground in winter.

In an investigation into metabolic rate, the oxygen consumption of a 2.5 kilogram marmot was measured before the start and over the first four days of its hibernation.

The results are shown in the table below.

Day	Oxygen consumption (cm ³ per gram of body mass per hour)
(before start of hibernation period)	1.8
1	1.4
2	0.3
3	0.2
4	0.2

- (i) Calculate the **total** volume of oxygen consumed by the marmot on Day 4.

Space for calculation

$$0.2 \times 2500g \times 24 \text{ hours} = \underline{12\,000} \text{ cm}^3 \text{ oxygen} \quad 1$$

- (ii) Explain how hibernation helps the marmot survive the adverse conditions of winter.

Lower heart rate/breathing rate/body temperature

Conserves/saves energy

- (b) Some species of small mammal with high metabolic rates enter a state of reduced activity each day to survive adverse conditions.

Give the term used to describe this state.

Daily torpor

1

- (c) Many species of bird avoid metabolic adversity by relocating to a more suitable environment.

- (i) Name this type of behaviour.

migration

1

- (ii) Specialised techniques are used to study long-distance bird movements.

Describe **one** such technique.

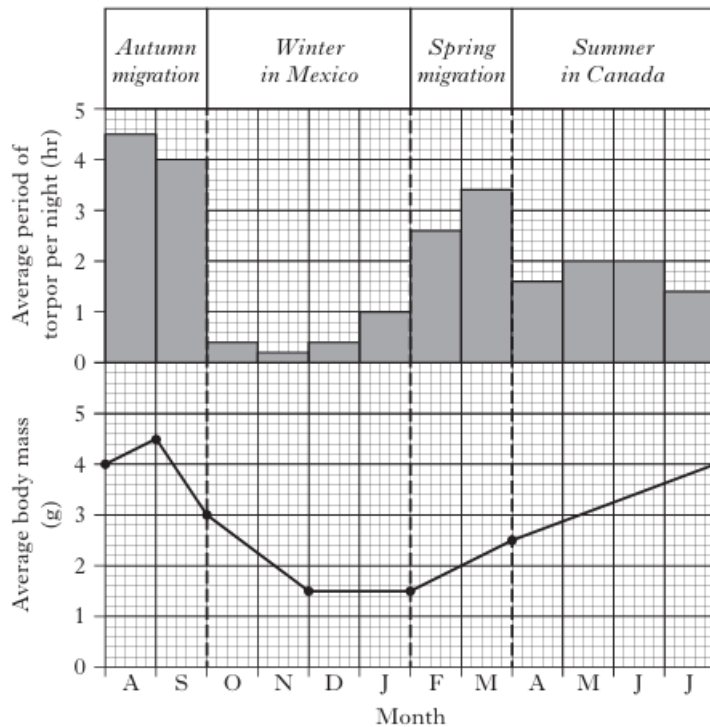
Satellite tracking/leg rings

Surviving & Avoiding Adverse conditions Past Papers

9. Rufous hummingbirds migrate thousands of kilometres each year between their summer breeding areas in Canada and their wintering areas in Mexico.

They feed on nectar throughout the year and save energy at night by entering a temporary state known as torpor in which body temperature and respiration rate are greatly reduced.

The **chart** below shows the average body mass of the hummingbirds and the average number of hours per night spent in torpor throughout the year.



- a) Describe a technique which could be used to track species such as the rufous hummingbird which undertake long distance migration.

Satellite tracking OR leg rings

- b) (i) Suggest why the increased time spent in torpor during migration is an advantage to the birds.

Saves energy FOR flying/migration

- (ii) Suggest **one** reason for the increase in body mass of the birds during the summer in Canada.

More food available OR less energy spent keeping warm

- (iii) Calculate the average period of torpor per month throughout the winter in Mexico.

Space for calculation

0.5

hours per night

- (c) The **table** below shows how the average oxygen consumption of the birds at rest is affected by their body temperature.

Body temperature	Average oxygen consumption at rest (cm ³ per gram of body mass per hour)
Normal	15.0
Lowered during torpor	2.0

Using information from the **chart** and the **table**, calculate the average volume of oxygen consumed per hour by a hummingbird at the end of September at normal body temperature.

Space for calculation

45 cm³