1. Choose the best example of acclimatization:

A) Arctic char have a higher swimming speed at 8°C relative to 4°C.
B) Woolly caterpillars synthesize glycerol prior to autumn freezing temperatures to lower the freezing point of the cytosol to control ice formation.
C) Marine fishes in the Arctic are very sluggish due to the cold.
D) Arctic mammals such as the Arctic fox have a countercurrent thermal exchange system in their limbs to inhibit heat loss from the paws in contact with snow or ice.
E) Arctic ground squirrels have a high surface area : volume ratio and lose heat faster in cold ambient temperatures relative to larger mammals.

1. A) No indications of why (no mention of an environmental change)
B) CORRECT
C) This is a fact, but is not related to seasonal change
D) This is true, but is an adaptation
E) This is also true but is not related to a seasonal change

2. Animals gain and lose heat by:

A) Evaporation, convection, conduction, and radiation.
B) Evaporation, convection, catabolism, conduction, and radiation.
C) Evaporation, vaporization, convection, conduction, and radiation.
D) Evaporation, convection, conduction, capillary action, and radiation.
E) Evaporation, convection, conduction, radiation, and reabsorption.

2. A) CORRECT

3. One of the <u>benefits</u> of ectothermy is a lower requirement for energy intake relative to endothermy, whereas the <u>costs</u> of ectothermy include:

A) More water loss from the high rate of respiration.
B) Less time available for reproduction.
C) Limited range of suitable habitats.
D) More time required for foraging.
E) Dependence on skeletal muscle activity to generate heat.

3. A) Water loss from respiration would be lower in ectotherms (benefit)
B) One of the benefits of ectothermy is there would be theoretically more energy devoted to growth and reproduction rather than cell metabolism. The statement is therefore false.
C) CORRECT
D) Less time required for foraging (benefit)
E) False, ectotherms do not depend on internal metabolism to generate heat.

A) Endotherms thermoregulate by absorbing radiation from the sun and other sources to maintain homeostasis.
B) Endotherms generate their own internal heat through metabolism, thereby thermoconforming and acclimatizing to new seasonal conditions.
C) Endotherms conform, whereas ectotherms regulate internal temperature relative to ambient temperature.
D) Ectotherms rely on the environment for sources of heat and may regulate cellular processes (e.g., cell membrane composition, heat-shock protein levels) to cope with temperature change.
E) Ectotherms may be both conformers and regulators depending on the environmental variable, but homeostasis is always maintained.

4. A) No, endotherms generate heat from metabolism.
B) First part is true, but they thermoregulate not thermoconform.
C) No, endotherms regulate
D) CORRECT
E) First part is true, but homeostasis with respect to temperature is NOT maintained.

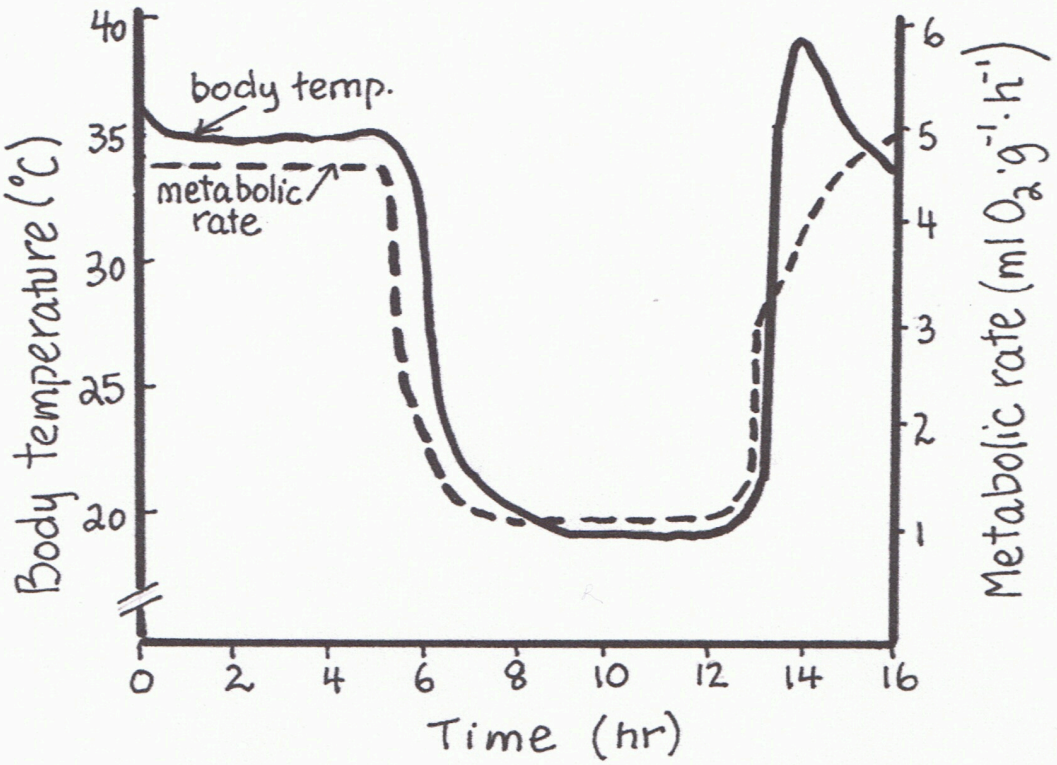
5. The muskox is active year round and therefore endures a wide range of temperatures. Below is a partially completed table of the time scale of responses to winter temperatures. Choose the answer below that best fits the missing information for blanks 1-4.

Timescale	Duration	Example of biological response
1	2	• large body size with short appendages
Acute	3	• vasoconstriction of peripheral blood vessels
Chronic	weeks to years	• 4

A) 1: general, 2: minutes to years, 3: minutes to hours, 4: undercoat is a soft fleece as fine as cashmere that insulates skin from ambient temperatures.
B) 1: generational, 2: multiple generations, 3: hours to weeks, 4: undercoat is a soft fleece as fine as cashmere that insulates skin from ambient temperatures.
C) 1: generational, 2: one generation, 3: weeks to years, 4: moult begins in late April or early May, old coat is shed in patches and they take on a tattered appearance.
D) 1: long term, 2: many years, 3: weeks to years, 4: migrate to higher grounds in the winter where they forage for Labrador tea, crowberry, cowberry and bilberry plants under the snow.
E) 1: generational, 2: multiple generations, 3: minutes to hours, 4: migrate to higher grounds in the winter where they forage for Labrador tea, crowberry, cowberry and bilberry plants under the snow.

5. E) CORRECT

Examine this figure which presents some physiological data, and then answer the questions below.



6. Which statement best describes the data shown in the figure?

A) Body temperature decreased from 5 to 1°C between 5 to 6 hr at the same time metabolic rate declined from 35 to 20 ml $O_2 \cdot g^{-1} \cdot h^{-1}$. After 13 hr, both variables returned to the values observed at 0 hr.

B) Body temperature and metabolic rate were fairly constant until 5-6 hr when there was a substantial decrease in body temperature (about -15°C) and metabolic rate (about ~3.5 $ml \cdot g^{-1} \cdot h^{-1}$). After 16 hours, body temperature initially increased above the 0 hr temperature.

C) Body temperature and metabolic rate changed more or less in parallel but metabolic rate between 13-14 hr overshot the value observed at 0 hr.

D) Body temperature was always higher than metabolic rate until ~8 hr, while in the recovery phase body temperature was lower than metabolic rate.

E) Body temperature declined by about 15°C and metabolic rate declined by about 3.5 ml $O_2 \cdot g^{-1} \cdot h^{-1}$ after 5 hr. Both variables rose after 13 hr.

6. A) Body temperature decreased from ~35 to 20°C between 5 to 6 hr.
B) First part is true, but we have no data post 16 hours.
C) First part is true, but metabolic rate did not overshoot.
D) This doesn't make any sense because the axes and units are different for each variable.
E) CORRECT

7. Based on the data in the previous figure, which is the most plausible biological interpretation?

A) The data are for an endotherm (e.g., deer mouse) that enters a short period of daily torpor.
B) The data are for an endotherm (e.g., Arctic ground squirrel) that enters seasonal hibernation.
C) The data are for a heterotherm (e.g., skipjack tuna) that is able to vary body temperature and metabolic rate in order to regulate swimming speed.
D) The data are for an ectotherm (e.g., lizard) that is moving between a daytime warmer environment to a night time cooler environment.
E) The data are for an ectotherm (e.g., Arctic ptarmigan) that enters torpor to conserve energy when food is scarce.

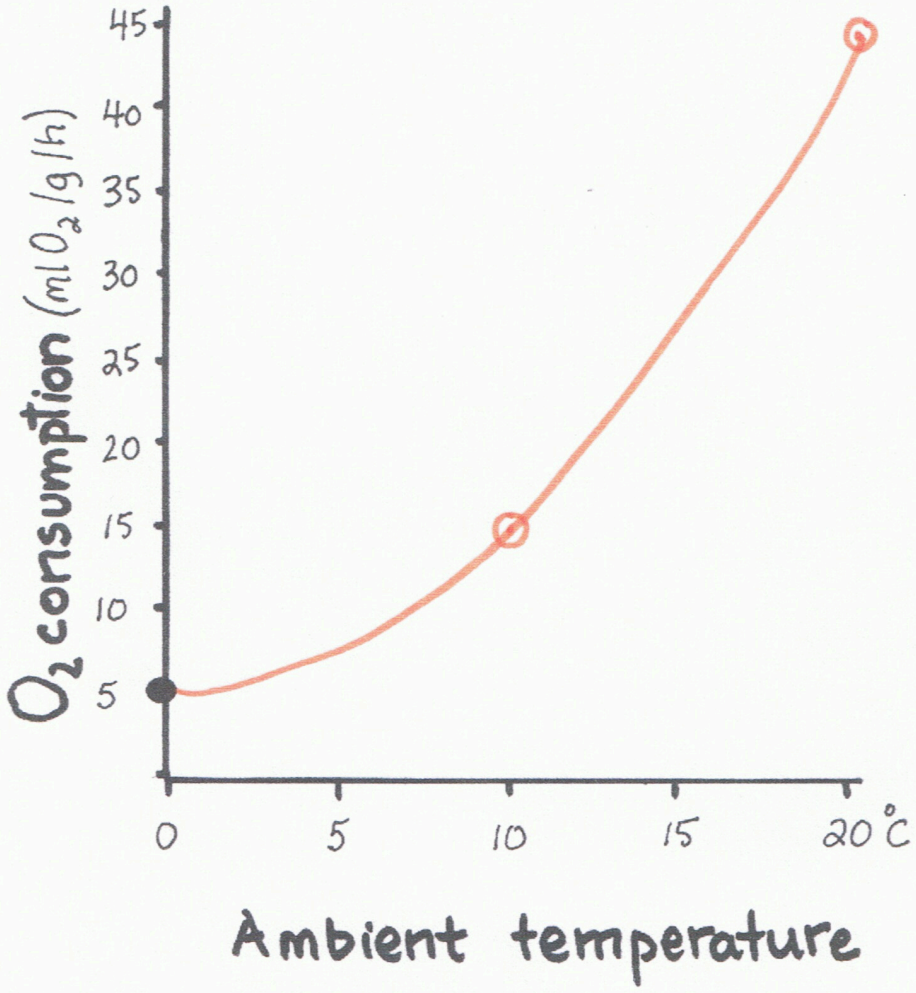
7. A) CORRECT
B) Time scale is not seasonal.
C) False, heterothermy in tuna concerns red muscle (warmer) versus rest of body (cooler). Metabolic rate would not follow this type of temperature difference.
D) The data are probably not for an ectotherm (35-37°C sounds suspiciously like a bird or mammal). The temperature overshoot at 12-14 hr is also mismatched with metabolic rate and it is unlikely that such a situation would occur in an ectotherm.
E) Arctic ptarmigan are not ectotherms.

8. The abiotic factors in the Arctic prevent the growth of a wide variety of photosynthesizing organisms, however the ones that do survive are very well adapted. Choose the correct statement below.

A) Lichens, the symbiosis between alga and fungus, thrive in the Arctic because they can grow without soil, are tolerant of freezing and dehydration, and can enter long periods of dormancy.
B) Lichens, the symbiosis between moss and fungus, thrive in the Arctic because they grow very quickly on a variety of surfaces (eg. rocks, trees, soil) and are extremely dessication tolerant.
C) Some Arctic plants are well adapted because they produce antifreeze (eg. propylene glycol), have a thin waxy cuticle on leaves and deep roots to obtain water below the permafrost.
D) Some Arctic plants, for example lichens, have adapted to the problem of limited habitat by growing in specialized habitats like rock and using sheltered microhabitats and south-facing slopes.
E) Most Arctic plants have a perennial life cycle and overcome the low nutrient content of soil by having hairy leaves and stems, a relatively small size and small leaves.

8. A) CORRECT
B) Lichens are not a symbiosis between moss and fungus.
C) First part is true, but arctic plants would have thicker waxy cuticle and shallow roots.
D) Lichens are not plants.
E) Most arctic plants have an annual life cycle, nutrients in soil are not connected to hairy leaves and stems.

The Q_{10} of the winter flounder is 3. The oxygen consumption at 0°C is given in the graph below as 5 mL O_2/g/h. Plot the expected oxygen consumption over the temperature range shown then answer the question below.



9. Which statement best describes the data in the graph you have plotted?

A) The relationship between ambient temperature and oxygen consumption is linear.
B) The relationship between ambient temperature and oxygen consumption is exponential.
C) The expected value of oxygen consumption at 10°C is 3 ml O_2/g/h.
D) The expected value of oxygen consumption at 10°C is 8 ml O_2/g/h.
E) The expected value of oxygen consumption at 20°C is 30 ml O_2/g/h.

9. B) CORRECT