SC20PB Exam Review

Dynamics of Ecosystems

1. Explain what is meant by each of the following terms.

   (a) species

   A group of organisms that can interbreed to produce fertile offspring

   (b) habitat

   The environment in which a species normally lives or the location of a living organism.

   (c) population

   A group of organisms of the same species which live in the same area at the same time.

   (d) community

   A group of populations living and interacting with each other in an area.

   (e) ecosystem

   A community and its abiotic environment.

2. What is the difference between biotic and abiotic factors?

   biotic: living
   abiotic: non-living

3. What is the difference between an autotroph and heterotroph?

autotroph: Organisms capable of making their own organic molecules as a food source from simple inorganic substances

heterotroph: Organisms that cannot make their own food from inorganic matter and must obtain organic molecules from other organisms

4. Distinguish between consumers, detritivores and saprotrophs.

Consumers: Any organism that relys on others for food.

Detritivores: ingest dead organic matter: eat dead leaves, feces, or carcasses.

Saprotrophs: live on or in non-living(dead) organic matter, secreting digestive enzymes into it and absorbing the products of digestion.

5. Consider the following food chain:

Algae → Plankton → Smelt → Perch → Walleye → Northern Pike → Bald Eagle

(a) What is meant by a food chain?

Food chain is a sequence showing the feeding relationships and energy flow between species. The direction of each arrow shows which way the energy flows.

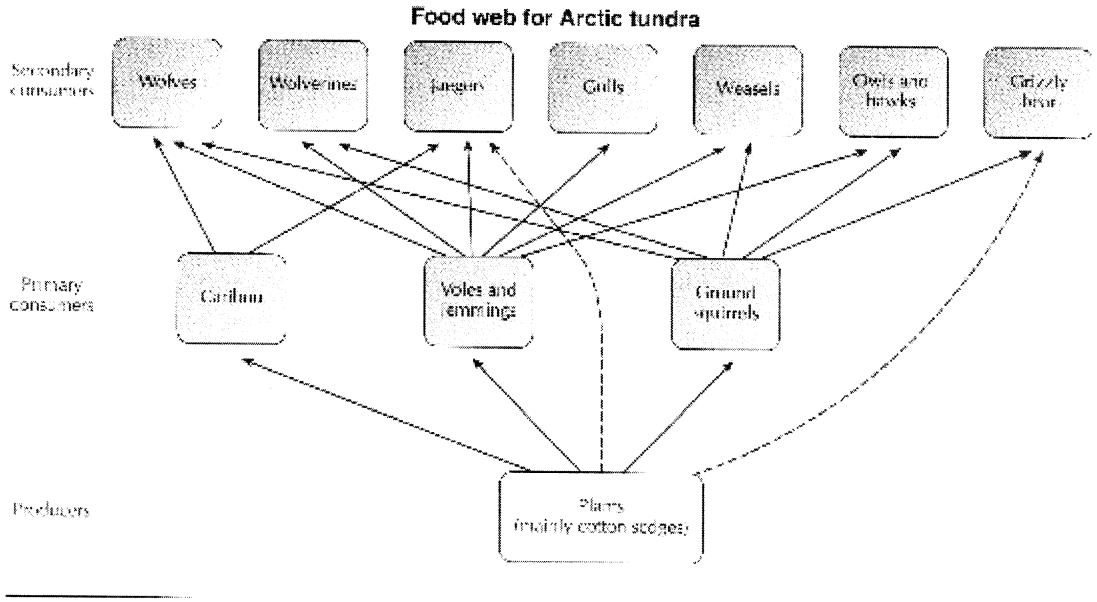
(b) What is meant by the trophic level of an organism?

Trophic level refers to an organism's position in a food chain

(c) In what trophic level are the algae?

producer

6. Construct a food web for the Arctic tundra using the following information.
   - Plants (mainly cotton Sedges) eaten by caribou, voles, lemmings, ground squirrels, jaegers, grizzly bears
   - caribou are eaten by wolves, jaegers
   - voles and lemmings are eaten by wolves, wolverines, jaegers, gulls weasels, owls, hawks
   - ground squirrels are eaten by wolves, wolverines, weasels, owls, hawks, and grizzly bears



7. What is the initial energy source for almost all communities?

   sunlight

8. Explain the shape of energy pyramids that are constructed to represent energy flow in an ecosystem.

   less energy flows through each successive trophic level. Energy is lost at each trophic level, so less remains for the next level.

9. Explain what is meant by the carbon cycle. Use the words photosynthesis and cellular respiration in your answer. You may use a diagram.

plants absorb carbon dioxide from the atmosphere
carbon dioxide (and water) are converted to carbohydrates by photosynthesis
consumers eat the plant absorbing the carbohydrates
carbohydrates (and oxygen) are converted to carbon dioxide by cellular respiration

10. This question is about the nitrogen cycle.

(a) How does a plant get the nitrogen that it needs to grow?

nitrogen from the air is converted to nitrates by bacteria that live in the nodules of legumes
plants absorb the nitrates through their roots

(b) What would be a potential problem of over fertilization?

excess nitrogen could run-off into rivers and lakes providing more nitrogen for aquatic plant life
the aquatic plants could grow large enough to crowd out the other organisms that live in that habitat

11. Define biomagnification and give an example of how it works.

increase in concentration of a pollutant from one link in a food chain to another

12. How is population size affected by each of the following:

    (a) natality
    increases

    (b) mortality
    decreases

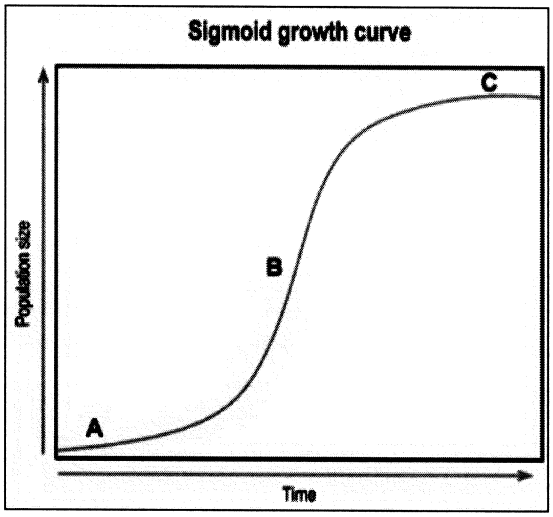
    (c) immigration
    increases (individuals entering the population)

    (d) emigration
    decreases (individuals leaving the population by means other than death)

13. State and explain what happens when a population reaches and exceeds the carrying capacity.

    the death rate within the population increases

14. Consider the following population growth curve.



    Indicate the letter that represents each of the following:

    (a) exponential growth phase ___A_____

    (b) plateau phase ___C_____

    (c) transitional phase ____B_____

15. Factors that affect population density are either density-dependent or density-independent. Define each of these terms and provide an example of each.

(a) Density Dependent factor

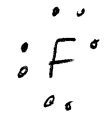
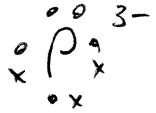
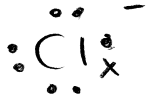
Factors that increase in significance as a population grows

(b) Density Independent factor

the effect on population size does not depend on how many individuals there are in the population

Chemistry In Action

16. Draw an electron dot diagram for each of the following:

(a) Sodium	(b) Magnesium	(c) Fluroine	(d) Sulfur
			
(e) Neon	(f) K^+	(g) P^{3-}	(h) Cl^-
			

17. Name the following compounds:

(a) $AgNO_3$ *silver nitrtate*

(b) PbO *lead(II) oxide*

(c) C_3H_6 *tricarbon hexahydride*

(d) $CuSO_4$ *copper(II) sulfate*

(e) $Fe(OH)_3$ *iron(III) hydroxide*

(f) Na_3PO_4 *sodium phosphate*

(g) CaS *calcium sulfide*

(h) SiO_2 *silicon dioxide*

(i) $MgCrO_4$ *magnesium chromate*

(j) KSCN *potassium thiocyanate*

(k) $K_2Cr_2O_7$ *potassium dichromate*

(l) $(NH_4)_3PO_4$ *ammounium phosphate*

18. Write the chemical formula for each of the following compounds.

(a) magnesium sulfide MgS

(b) nitrogen trioxide NO_3

(c) Sodium cyanide $NaCN$

(d) Potassium nitrite KNO_3

(e) Lead(IV) sulfide PbS_2

(f) Copper(II) hypochlorite $Cu(ClO)_2$

(g) Mercury(II) silicate $HgSiO_3$

(h) Lithium citrate $Li_3C_6H_5O_7$

(i) Ammonium acetate $NH_4C_2H_3O_2$

(j) Tin(II) permanganate $Sn(MnO_4)_2$

(k) Magnesium nitride Mg_3N_2

(l) Manganese(IV) perchlorate $Mn(ClO_4)_4$

19. Write a balanced chemical equation for each of the following reactions and indicate the type of reaction.

(a) Sodium and chlorine combine to form sodium chloride.

$2Na + Cl_2 \rightarrow 2NaCl$ *(synthesis)*

(b) Aluminum and copper(II) chloride are mixed and copper and aluminum chloride are formed.

$2Al + 3CuCl_2 \rightarrow 2AlCl_3 + 3Cu.$ *(single displacement/replacement)*

(c) Hydrogen peroxide (H_2O_2) decomposes to form hydrogen gas and oxygen gas.

$H_2O_2 \rightarrow H_2(g) + O_2(g)$ *(syntheses)*

(d) Propane (C_3H_8) reacts with oxygen to form carbon dioxide and water.

$C_3H_8 + 5\ O_2 \rightarrow 3CO_2 + 4\ H_2O$ *(combustion)*

(e) Sodium acetate and copper(II) nitrate are combined to form copper(II) acetate and sodium nitrate.

$2NaC_2H_3O_2 + Cu(NO_3)_2 \rightarrow Cu(C_2H_3O_2)_2 + 2NaNO_3$ *(double displacement)*

20. List 2 properties of acids and 2 properties of bases.

Acids	Bases
Taste sour *Corrode metal*	*Taste bitter* *Feel slippery*

21. Identify 2 common household acids and 2 common household bases.

Acids	Bases
Fruit juices *Carbonated beverages* *Car battery*	*Soap* *Window cleaner* *Drain cleaner* *Quinine*

22. What are the reaction products when an acid is combined with a base?
a salt and water

23. Perform the following particle-mole-mass conversions.

(a) 8.90×10^{25} atoms of oxygen to moles

$\frac{8.90 \times 10^{25}}{6.02 \times 10^{23}} = 147.8 \text{ mol}$

(b) 9.62 mol of copper(II) sulphate to grams $CuSO_4$ mass $= 63.5 + 32.1 + 4(16) = 159.6 \text{ g mol}^{-1}$

1 mol = 159.6 g

9.62 mol = ?

1535 g

(c) 7.90×10^{22} molecules of butane (C_4H_{10}) to grams C_4H_{10} mass $= 4(12) + 10(1.01) = 58.1 \text{ g}$

6.02×10^{23} molecules = 58.1 g

7.90×10^{22} = ?

7.6 g

(d) 24 grams of NaCl to moles NaCl mass = 23 + 35.5 = 58.5 g

1 mol = 58.5 g

? = 24 g

0.41 mol

(e) 0.8 mol of MgO to molecules

1 mol = 6.02×10^{23}

.8 = ?

4.82×10^{23} molecules

24. A chemist has a sample of ammonium dichromate that has a mass of 21.87g.

(a) Write the chemical formula for ammonium dichromate.

$(NH_4)_2Cr_2O_7$

(b) Calculate the molecular mass of ammonium dichromate.

$2(14) + 8(1.01) + 2(52) + 7(16) = 252.08 \text{ g mol}^{-1}$

(c) Calculate the number of moles of ammonium dichromate the scientist has.

1 mol = 252.08 g

? 21.87 g

0.087 mol

(d) How many moles of hydrogen atoms are present within the sample?

$8(0.087) = 0.696$ mol of H atoms

25. Determine the percent by mass of each element in each of the following compounds.

(a) $CaCO_3$ $40.1 + 12 + 3(16) = 100.1\ g$

Ca: $\frac{40.1}{100.1} = 40\%$

C: $\frac{12}{100.1} = 12\%$

O: $\frac{16(3)}{100.1} = 48\%$

(b) KF $39.1 + 19 = 58.1$

K: $\frac{39.1}{58.1} = 67.3\%$

F: $\frac{19}{58.1} = 32.7\%$

26. A sample of toluene, a toxic organic molecule that can cause brain damage in sufficient quantity, is composed of 84.1 g of carbon and 8.08 g of hydrogen. What is the empirical formula of toluene?

C: $\frac{84.1}{12} = 7.008/7.008 = 1 \times 7 = 7$

H: $\frac{8.08}{1.01} = 8/7.008 = 1.14 \times 7 = 8$

C_7H_8

27. Nitro-glycerin is used as both a powerful explosive and as a treatment for heart conditions such as angina (a lack of blood to the heart which causes extreme pain and can be quite dangerous. Nitro-glycerin is composed of 15.86% Carbon, 2.23% Hydrogen, 18.50% Nitrogen and 63.41% Oxygen.

(a) Determine the empirical formula for nitro-glycerin.

C: $\frac{15.86}{12} = 1.3217 / 1.3214 = 1 \times 3 = 3$

H: $\frac{2.23}{1.01} = 2.2079 / 1.3214 = 1.67 \times 3 = 5$

N: $\frac{18.50}{14} = 1.3214 / 1.3214 = 1 \times 3 = 3$

O: $\frac{63.41}{16} = 3.963 / 1.3214 = 3 \times 3 = 9$

$C_3H_5N_3O_9$

(b) The molar mass of nitro-glycerin is 227.09 $gmol^{-1}$. What is the molecular formula?

$C_3H_5N_3O_9$

$3(12) + 5(1.01) + 3(14) + 9(16) = 227.05$

$\frac{227.09}{227.05} = 1$

$C_3H_5N_3O_9$

Measurement

28. State the number of significant digits in each of the following:

(a) 350 *2*

(b) 201 *3*

(c) 9845.098 *7*

(d) 870.50 *5*

(e) 0.0045 *2*

(f) 0.000006 *1*

(g) 0.0098300 *5*

29. An object has a volume of 50 cm^3 and a mass of 15 g. Calculate the density of the object.

$$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{15\text{g}}{50\ \text{cm}^3} = 0.3\ \text{g cm}^{-3}$$

30. Convert the following:

(a) 80 kmh^{-1} = ___*22.2*___ ms^{-1}

(b) 35 ms^{-1} = ___*126*___ kmh^{-1}

(c) 2.4 hours = ___*8640*___ seconds

(d) 72 seconds = ___*0.02*___ hours

In Motion

31. Frank can run 100 m in 9.58 s.

(a) What is his average speed in ms^{-1}?

$$v = \frac{d}{t} = \frac{100\ m}{9.58\ s} = 10.44\ ms^{-1}$$

(b) Assuming he can run at this average speed for 30 minutes, how far will he travel?

30 minutes = 30(60) = 1800 s

$$v = \frac{d}{t}$$

$$10.44\ ms^{-1} = \frac{d}{1800\ s} \qquad d = 18792\ m$$

(c) Assuming he can run at this average speed for an extended period of time, how long would it take him to run a distance of 200 km?

200 km = 200 000 m

$$v = \frac{d}{t}$$

$$10.44\ ms^{-1} = \frac{200\,000\ m}{t} \qquad t = 19157\ s \text{ or } 5.32 \text{ hours}$$

32. Fred Flintstone can accelerate his car from 2.5 m/s to 15 m/s in a time of 10 seconds.

(a) What is the acceleration of the car?

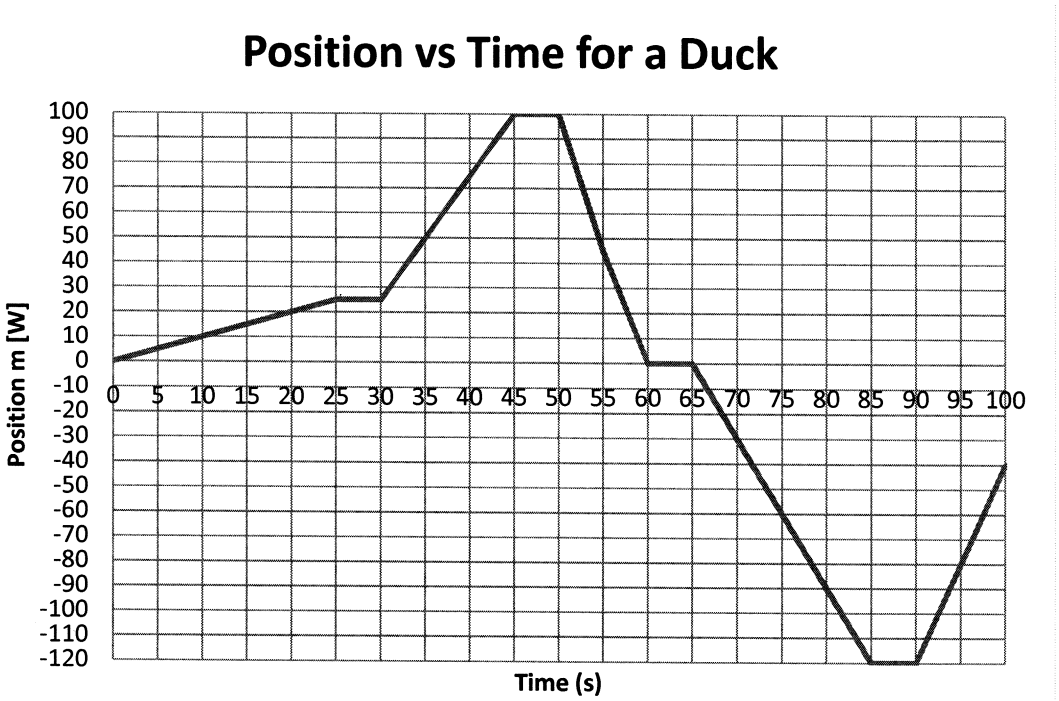
$$a = \frac{v_f - v_i}{\Delta t} = \frac{15\ m/s - 2.5\ m/s}{10\ s} = 1.25\ m/s^2$$

(b) What is his speed after 7 seconds?

$$a = \frac{v_f - v_i}{\Delta t}$$

$$1.25\ m/s^2 = \frac{v_f - 2.5\ m/s}{7\ s} \qquad v_f = 11.25\ ms^{-1}$$

33. Consider the following position-time graph.



(a) How far does the duck travel in the trip?

100 m + 100 m + 120 m + 80 m = 400 m

(b) What is the displacement of the duck over the entire trip?

-40 − 0 = -40 40 m East

(c) Describe the motion (speed and direction) of the duck during the following time intervals:

(i) 0-25 s

moving forward (west) at a constant velocity

(ii) 45-50 s

stationary

(iii) 60-65 s

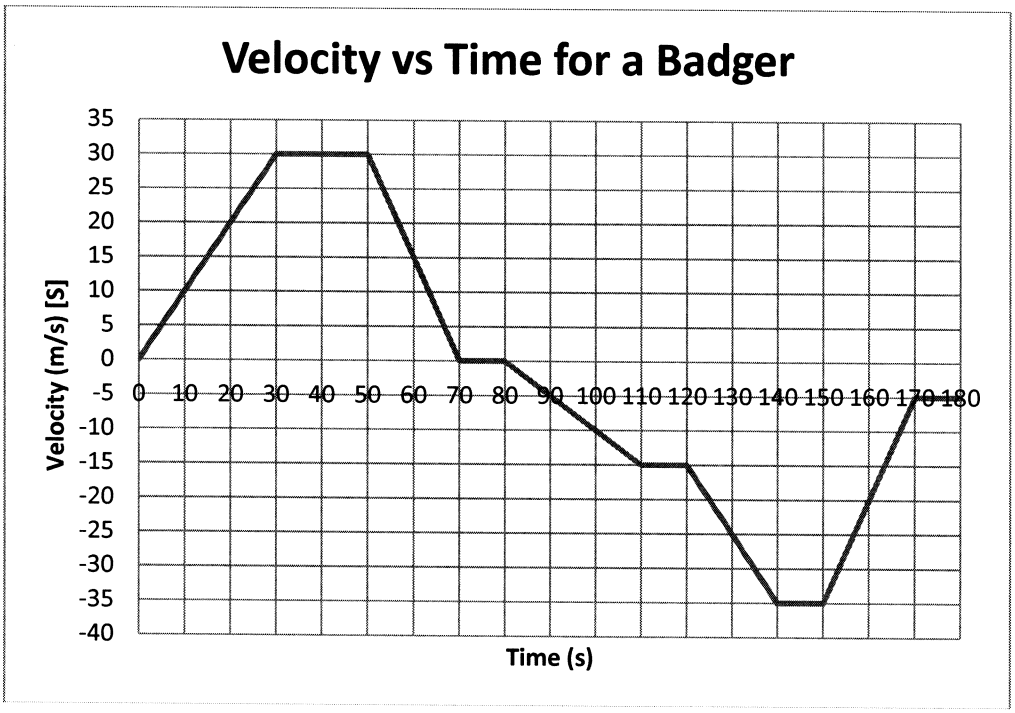
stationary

(d) What is the velocity of the duck from 50 – 60 s?

Velocity is slope

$v = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{0 - 100}{60 - 50} = -10\ ms^{-1}$ or $10\ ms^{-1}$ East

34. Consider the following velocity-time graph to answer the following questions.



35. Describe the motion of Billy the Badger (speed, direction) during the following time intervals:

(a) 0 – 30 s

speeding up while traveling forward (south)

(b) 70 – 80 s

moving forward (south) at a constant velocity

(c) 140 – 150 s

moving backward (north) at a constant velocity

(d) 150 – 170 s

slowing down while traveling backward (north)

(e) Calculate the badger's acceleration from 120 – 140 seconds.

$$a = \frac{v_f - v_i}{\Delta t} = \frac{-35 - -15}{140 - 120} = \frac{-20}{20} = -1\ ms^{-2}$$

36. In your own words, describe Newton's three laws of motion.

First Law *an object at rest remains at rest and an object in motion remains in motion, unless acted upon by an external unbalanced force.*
Second Law *Force is proportional to mass and acceleration*
Third Law *To every action there is an equal and opposite reaction* *Forces come in pairs*

37. Define momentum and give an example.

Momentum is a property that depends on the mass and the velocity of the object

all moving objects have momentum
if a light weight object and a heavy object have the same velocity, then the heavy object will have more momentum
if two objects have the same mass, the faster object has more momentum

38. A deer runs out in front of a car traveling 100 km/h on an icy road (k=0.25). If the deer is 250 m away, will the car stop in time?

$d = kv^2$ $\quad 100\ km/h \times \frac{(1000)}{3600} = 27.78\ m/s$

$= (0.25)(27.78)^2$

$= 193\ m$

yes, the car will stop in time

39. Explain how reaction time changes the amount of time required to stop a vehicle.

While you are reacting, the car continues to move forward
someone with a short reaction time will be able to stop sooner than someone with a longer reaction time

40. Choose one safety feature on a car and explain how it works to reduce injury to the passengers.

(any reasonable response based on the information in the handout)

Weather Dynamics

41. What is the most abundant gas in the atmosphere?
    nitrogen

42. Which layer of the atmosphere is closest to the earth?
    troposphere

43. Explain what is meant by the hydrosphere.

    all of the water on the earth

44. Explain each of the following:

    (a) ozone layer

    layer near the top of the stratosphere containing a high concentration of ozone

    (b) high pressure system

    air is pushing down

    (c) low pressure system

    air is rising up

    (d) Coriolis effect

    the apparent bending of the motion of the wind due to the rotation of the earth

    (e) albedo

    the ratio of sun light reflected to the amount of sun light absorbed

    (f) jet stream

    fast moving wind in the upper atmosphere that forms between areas of warm and cooler air – they steer storms

(g) prevailing winds

the direction the wind tends to blow in an area
(in Winnipeg the prevailing winds are from the west)

(h) Fujita scale

scale used to measure the strength of a tornado

45. What happens during the weather pattern known as El Niño?

warmer than normal ocean temperatures across the central and eastern tropical Pacific Ocean.
increased convection or cloudiness in the central tropical Pacific Ocean
weaker than normal (easterly) trade winds
resulting in warmer winter weather for western Canada

46. List three "greenhouse" gases.

water vapor
carbon dioxide
methane

47. The following question is about extreme weather events.

(a) Explain how a thunderstorm forms.

warm moist air rises
clouds form as warm air carrying moisture rises within cooler air
as the warm air rises, it cools
the moist water vapor begins to condense
as the moisture condenses, energy is released keeping the air warmer than its surroundings, so that it continues to rise
if enough instability is present, the process will continue long enough until cumulonimbus clouds form

(b) How could you stay safe in a thunderstorm?

seek shelter in an enclosed building or car
if outside, lie flat
in a forest, crouch down by small low lying bushes
(any other reasonable statement)

(c) Explain how a tornado forms.

the air in the updraft of a thunderstorm starts to spin
small cyclones of air in the updraft intensify
the air pressure in the center of the cyclone is lower causing it to spin faster and narrower
a funnel cloud appears

(d) What should you do in the event of a tornado?

go to the basement
go to a designated tornado shelter
stay away from windows and outside walls
(any other reasonable statement)

(e) What conditions are required for Environment Canada to label a snow storm a blizzard?

heavy falling or blowing snow
winds exceeding 40 km/h
wind chill less than -25°C
visibility reduced to less than 400 m
for at least 4 hours