LESSON 3
ADMINISTERING OXYGEN

3-1. GENERAL

Oxygen is essential to life. It cannot be stored in the body. The supply of oxygen must be constant and in sufficient amounts to sustain the life of the body's cells. Body tissues die when they are deprived of oxygen. Brain cells can be damaged beyond recovery in three to seven minutes.

3-2. HYPOXEMIA AND OXYGEN THERAPY

Normally, the 21 percent concentration of oxygen in inspired room air is adequate for the body. However, after any severe disturbance of the respiratory or circulatory system, hypoxemia (low level of oxygen in the blood) can occur. Hypoxemia can occur at varying levels. If it is severe, it may cause irreversible tissue damage in a short period of time. Oxygen therapy may be used for acute or chronic conditions that cause hypoxemia.

a. Signs and Symptoms of Hypoxemia. Signs and symptoms of hypoxemia include:

(1) Increased heart rate (tachycardia).
(2) Increased respiratory rate (tachypnea).
(3) Difficult or labored breathing (dyspnea).
(4) Shortness of breath.
(5) Restlessness.
(6) Mental confusion and weakness.
(7) Cyanosis (bluish tint of skin--a late sign).

b. Treatment of Hypoxemia. Hypoxemia is treated by administering extra oxygen (oxygen therapy). Oxygen is administered in low concentrations to relieve the effects of hypoxemia. Prolonged oxygen therapy and/or high doses may cause respiratory complications such as hyperventilation or atelectasis.

(1) Oxygen is normally supplied from tanks (also called cylinders and bottles) or from wall outlets (piped-in oxygen).
Oxygen is considered a drug and, as such, requires a physician’s order before it can be administered to a patient except in certain emergency conditions. The physician will prescribe the dose (flow rate), method (mask or nasal prongs), and duration of the oxygen therapy.

3-3. IDENTIFYING NEED FOR OXYGEN THERAPY

Certain medical conditions require that the patient receive oxygen in greater amounts than is available in the atmosphere. In some medical conditions oxygen therapy is to be avoided (contraindicated).


(1) Cardiac conditions, such as heart attack and congestive heart failure, require oxygen therapy. Congestive heart failure (CHF) is a condition in which the heart fails to maintain an adequate output, resulting in a diminished blood flow to the tissues and congestion in the pulmonary and/or systemic circulation.

(2) Pulmonary edema (an excessive collection of fluid in the pulmonary tissues and air spaces), shock, hemorrhage, or any airway obstruction requires the use of oxygen. An acute respiratory failure and/or pulmonary insufficiency (impaired gas exchange between the circulating blood and the surrounding air) also require the administration of oxygen.

b. Conditions That Contraindicate Oxygen Therapy.

(1) Hyperventilation. Hyperventilation is an abnormally rapid breathing rate that produces an excess of oxygen and insufficient carbon dioxide in the blood.

(a) Signs and symptoms. The signs and symptoms of hyperventilation include rapid and unusually deep breathing; extreme anxiety and apprehension; dizziness; numbness of hands, fingers, toes, lips, and tongue; healthy pink color to the skin; stabbing chest pain; flexed position of the hands with thumbs curved toward the palms; and trembling and muscle cramping of the extremities.

(b) Treatment for hyperventilation. Reassure the patient and encourage him to slow his breathing rate. Place a paper bag or other suitable item over the patient’s nose and mouth and have him breathe into and from the bag. This causes the patient to rebreathe the exhaled air that has a high concentration of carbon dioxide.

(2) Chronic pulmonary diseases (unless directed by a physician). These diseases include asthma, chronic bronchitis, and emphysema. These conditions require oxygen to be administered in low doses (1 to 2 liters per minute) ONLY to relieve the symptoms of hypoxemia. Excessive oxygen could lead to respiratory arrest.
3-4. DELIVERY DEVICES

The two major devices for oxygen delivery are the simple face mask and the nasal prongs (cannula). The amount of oxygen delivered is dependent upon the flow rate (given in liters per minute) and the patient's respiration rate.

a. Nasal Prongs. The nasal prongs (nasal cannula) is the device most frequently used to administer a low concentration of oxygen. It is a short, disposable, plastic tube with two plastic prongs that fit into the patient's nostrils. It is held in place with an elastic headband (figure 3-1). The nasal cannula is relatively comfortable and enables the patient to eat, talk, and move without difficulty; however, the prongs can be easily dislodged by restless or disoriented patients. To be effective, the patient's nasal passages must be clear.

![Figure 3-1. Nasal cannula.](image)

b. Face Mask. The most commonly used oronasal face mask is a disposable, clear plastic type that covers the nose and mouth (figure 3-2). Exhaled air passes through small holes in the sides of the mask. These holes also allow room air to be drawn in and mixed with the oxygen (figure 3-3). This device must be used with caution with patients who may be unable to maintain a clear airway, including patients who may vomit easily and are unable to remove the mask to prevent aspiration of the stomach contents. The mask must be replaced with nasal prongs while the patient eats and put back in place after he has finished the meal. Use the face mask, not the prongs, if the patient is unconscious or has an artificial airway.
3-5. PROCEDURE FOR SETTING UP AN OXYGEN TANK

The nasal prongs and the face mask require an oxygen source, usually from an oxygen tank or from piped-in oxygen. Most fixed-facility hospitals have piped-in oxygen. However, older hospitals and nonfixed facilities rely on oxygen tanks (figure 3-4) to deliver oxygen. If an oxygen tank is to be used, it must be properly prepared.

a. Determine Need to Set up an Oxygen Tank. In a hospital, you will set up an oxygen tank when required to do so by orders from the physician or supervisor or when required to do so by the standing operating procedures (SOP). In a field situation, the medic must use his own judgment in determining the need for oxygen.
b. **Perform Handwash.** Follow procedures for performing a patient care handwash.

c. **Obtain Equipment.** Obtain the following equipment as needed.

   (1) **Full oxygen tank (cylinder).** Oxygen tanks are usually kept in a central location designated by the hospital SOP.

      (a) Oxygen tanks are color coded (painted) **green**; however, the international color code for oxygen is **white**.

      (b) Tanks are available in various sizes, but the most commonly used tanks are D, E, and M cylinders. The "D" tank contains 356 liters of oxygen; the "E" contains 650 liters; and the "M" contains 3,000 liters. Each is filled to specified limits with a pressure of from 2,000 to 2,200 pounds per square inch (psi). As the oxygen is used, the pressure decreases. A tank is considered to be sufficiently pressurized for use as long as it maintains a pressure of 200 psi or greater.

      (c) Check the tag on the oxygen cylinder. The oxygen cylinder tag is a three-part perforated design with the three sections labeled "Full," "In Use," and "Empty" (figure 3-5). The tag should have all three sections intact. When the cylinder is turned on for use by the patient, the "Full" segment is torn off. When the tank is empty, the "In Use" segment is removed, leaving the only the "Empty" portion of the tag. The tank is considered to be empty when the gauge reads 200 psi.

   (2) **Oxygen cylinder truck, if applicable.** A transport designed for gas cylinders must be used when moving a large ("M") oxygen cylinder.

   (3) **Cylinder regulator.** The cylinder regulator (figure 3-6) is used to control the flow of oxygen from the cylinder. The oxygen in the cylinder is under great pressure. By controlling the rate at which oxygen leaves the cylinder, the oxygen pressure is lowered to a pressure that is safe for the patient. The regulator ensures a steady, even flow of oxygen and provides a means for adjusting the rate of flow. The cylinder regulator has two gauges.

      (a) The cylinder contents gauge shows the amount of oxygen in the cylinder and is calibrated in pounds of pressure per square inch (psi). When the tank is almost depleted (a pressure of 200 psi is considered to be "on empty"), the needle points to a red warning that the tank needs to be replaced.

      (b) The second gauge, called a flow meter (or flow indicator gauge) shows the amount of oxygen being delivered and is calibrated in liters per minute. There are two main types of flow meters. One is the Bourdon gauge (round type) shown in figure 3-6. The other is the pressure compensated flow meter that works on gravity and must be kept upright. A pressure compensated flow meter is shown in figure 3-12.
Figure 3-5. Cylinder tag.

Figure 3-6. Cylinder regulator.
CAUTION: Because of the extreme pressure in these tanks, they should be handled with the utmost care and respect. If the tanks are violently banged together, dropped, or knocked over, the valve may be broken. A broken valve can cause the tank to become an uncontrolled torpedo-like object, destroying whatever is in its path.

(4) **Humidifier.** A humidifier (figure 3-7) is used to add moisture to the oxygen. This helps to prevent drying and irritation of the patient's mucous membranes during the administration of oxygen.

(5) **Distilled water.** One liter of distilled water is needed to fill and replenish the humidifier.

(6) **Nonsparking cylinder wrench.** Nonsparking wrenches (figure 3-8) are used to reduce the chance of a spark occurring in case the wrench hits against the metal cylinder. Nonsparking wrenches are usually made of brass. A nonsparking wrench is normally attached to the cylinder stand or carrier.

(7) **Oxygen delivery system.** An oxygen delivery device (nasal prongs or face mask) and tubing to connect the delivery device to the oxygen supply is needed. This is used per physician's orders or supervisor's directive.

(8) **"No Smoking" signs.** Three "No Smoking" signs are needed.
d. **Remove Cylinder Valve Cap.** All oxygen cylinders have a steel cap that is screwed onto the top of the cylinder to protect the valve from damage while the cylinder is not in use. The cap may be difficult to remove or noisy during removal. **Do not** oil the threads of the cylinder cap. Even though oxygen itself does not burn or explode, it does support combustion. In an oxygen-enriched atmosphere, a small spark can cause flammable objects (bed linen, and so forth) or flammable liquids (oil, and so forth) to burst into flames. Remove the cylinder valve cap by turning it counterclockwise with your hand.

e. **"Crack" the Cylinder.** "Crack" the cylinder by fitting a handwheel over the cylinder stem, quickly turning the cylinder handwheel counterclockwise to open the valve slightly, and immediately turning it back clockwise to close the valve (figure 3-9). The "cracking" procedure produces a loud hissing noise that can be frightening if not expected; therefore, it should be accomplished prior to moving the cylinder into the patient's room. "Cracking" the cylinder removes any dust particles that may have accumulated on the outlet.

   (1) If the cylinder valve does not have a handwheel, fit a nonsparking cylinder wrench over the stem, turn counterclockwise, and immediately turn back clockwise to close the valve. "M" cylinders usually have handwheels; the smaller cylinders usually do not.

   (2) If the cracking procedure does not result in a noisy rush of air through the valve, report the problem to your supervisor and obtain another cylinder.

f. **Move the Cylinder.** Move the cylinder into the patient's room at this time if so desired. However, you may wish to attach other devices before moving the cylinder. When the cylinder is taken to the patient area, put the cylinder beside the head of the bed away from doors, doorways, heaters, and areas that have heavy traffic.
g. **Attach the Cylinder Regulator.**

1. **"M" cylinder.** To attach the cylinder regulator to the oxygen cylinder, hold the gauges in the upright position. Then insert the male portion of the cylinder regulator inlet into the threaded outlet on the oxygen cylinder (figure 3-10). Use your hand to tighten the inlet nut located on the cylinder regulator. Complete the tightening of the nut with a nonsparking wrench.

2. **"D and "E" cylinders.** Attach the yoke regulator to the cylinder using the following procedures.

   a. Locate the three holes on the cylinder stem as shown in figure 3-11.

   b. Examine the yoke attachment and locate the three pegs that correspond to the holes on the cylinder stem (figure 3-11).

   c. Make sure that the "O" ring is present on the main peg of the attachment. If the ring is not present, an oxygen leak could develop.
Figure 3-10. Attaching a cylinder regulator.

Figure 3-11. Cylinder stem and yoke attachment.
(d) Holding the yoke attachment firmly in both hands, slide it over the cylinder stem, making sure the pegs are correctly seated in the proper holes. The main peg connects with the oxygen valve. The two lower pegs must fit into the two smaller holes below the valve. The two lower holes are a safety precaution. Each type of gas container (oxygen, nitrous oxide, and so forth) has the lower holes located in different positions. The different hole locations prevent an oxygen delivery system from being connected to a non-oxygen cylinder.

(e) Turn the viselike screw on the slide of the yoke attachment to secure it.

h. Fill the Humidifier. Fill the humidifier bottle with distilled water so that the water level is between the marked minimum and maximum levels (approximately 2/3 full). Refill as necessary to maintain water level above the minimum mark.

(1) Because oxygen is very drying to the mucous membranes, it is bubbled through water to add humidity that makes it less irritating to tissues. Oxygen may be administered without humidification for short periods such as in emergency situations or during transportation.

(2) Bacterial growth on oxygen humidifiers may occur. Therefore, humidifiers and tubing should be changed at least every 24 hours or in accordance with local SOP.

i. Attach the Humidifier to the Flow Meter. Remove the oxygen tube connector from the flow meter by turning the wing nut. Attach the wing nut on the humidifier to the flow meter and secure by tightening the wing nut (figure 3-12).

j. Attach the Administering Device. Open the package containing the device to be used in administering the oxygen (nasal prongs or face mask) only far enough to expose the end of the connecting tube. Attach the end of the connecting tube to the oxygen outlet on the humidifier. The rest of the device should remain in the wrapper until ready for use to protect it from dust and contamination.

k. Secure the Oxygen Cylinder. Secure the cylinder in accordance with the local policy. Some facilities have special devices used to secure oxygen cylinders. Other facilities use straps to secure the cylinder to stable areas such as the bed or the wall.

l. Post "No Smoking" Signs. Place one "No Smoking" sign on the head of the patient's bed, one on the door to the patient's room, and one on the oxygen tank.

m. Report the Setup Procedure. Report the completion of the setup procedure to the supervisor.
3-6. PROCEDURE FOR SETTING UP A WALL OXYGEN UNIT

When oxygen is to be obtained from a piped-in supply, a station valve is located on the wall. Two general types of station outlet valves are currently in use. One is a manually operated valve with which the oxygen is turned on and off with a knob (figure 3-13). The other type is the "quick connect" coupler to which a flow meter can be connected simply by plugging it into the valve (figure 3-14). Other piping outlets, such as vacuum, may be located in the same area with the "quick connect" oxygen outlet. The wall outlet is keyed so that only oxygen equipment can be plugged into an oxygen valve and only vacuum equipment can be plugged into a vacuum valve. Oxygen outlets are color-coded green and vacuum outlets are color-coded yellow.

a. Determine Requirement To Set Up Wall Oxygen Unit. The requirement for the wall oxygen unit to be set up will normally be obtained from the physician's order or from your supervisor.

b. Perform Handwash. Follow the procedures for performing a patient care handwash.
c. Obtain Equipment.

(1) Flow meter. Oxygen flows through the pipeline at a low pressure, usually 50-60 pounds per square inch. A flow meter (figure 3-15) must be attached to the wall outlet to control the flow of oxygen to the patient.

(2) Humidifier. The humidifier prevents drying and irritation of the patient's mucous membranes by adding moisture to the oxygen being inhaled.
(3) Distilled water. One liter of distilled water will be needed for the humidifier.

(4) Delivery device. Obtain the packaged nasal prongs or face mask as per physician's order or supervisor's directive.

(5) "No Smoking" Signs. The signs are to be placed strategically on the head of the patient's bed, on the oxygen equipment, and on the patient's door.

d. Fill Humidifier Bottle. Fill the humidifier bottle to the level indicated (about 2/3 full) with distilled water. Refill as necessary to maintain the water level above the minimal level.

e. Attach Humidifier to Flow Meter. Remove the oxygen tube connector from the flow meter by turning the wing nut. Attach the wing nut on the humidifier to the flow meter outlet; then secure the wing nut to the flow meter.

f. Attach Flow Meter to Wall Unit. Close or turn the flow-adjusting valve of the flow meter to the "off" position. (Closing or turning the flow adjusting valve/dial to the "off" position will prevent damage to the gauge caused by a sudden influx of oxygen under pressure.) Insert the flow meter adapter into the opening of the oxygen outlet (figure 3-16) and press until a firm connection is made. You will hear a small "hiss" when the connection has been made.

g. Attach Delivery Device. Open the package of the device (nasal prongs or face mask) only far enough to expose the end of the connecting tube. Attach the end of the connecting tube to the oxygen outlet on the humidifier. After the connecting tube is attached to the humidifier outlet, leave the rest of the device in the wrapper until it is ready to be used. This will protect it from dust and contamination.
Figure 3-16. Attaching flow meter to "quick connect" coupler.

h. **Report to Supervisor.** Report the accomplishment of the procedure to the supervisor.

3-7. **PROCEDURE FOR ADMINISTERING OXYGEN USING NASAL PRONGS OR FACE MASK**

a. **Identify the Patient.** Determine the patient's name by asking his name and by checking his identification bracelet and bed card.

b. **Explain the Procedure to the Patient.** Show the nasal cannula or facemask to the patient and explain what is going to happen during the administration of oxygen.

c. **Prepare the Equipment for Administering Oxygen.** Post a "No Smoking" sign on the outside of the patient's door in view of other patients and visitors. Ensure that the humidifier is filled to the proper level. (If the humidifier is too full, the bubbling water will overflow into the gauges.) Attach the humidifier to the flow meter and attach the connecting tube from the nasal cannula or facemask to the humidifier (paragraphs 3-5 and 3-6). Set the flow rate at two liters per minute. Feel to determine if the oxygen is flowing through the nasal tips of the cannula.
d. **Calculate the Duration of Flow.** The duration of flow is the estimated amount of time that a given cylinder of oxygen will supply oxygen at a given rate. A safety factor (the safe residual) is built into the formula.

1. Determine the pressure of the oxygen in the cylinder from the pressure gauge on the cylinder.

2. Determine the safe residual level. The safe residual established by the American Academy of Orthopedic Surgeons is 200 psi. Your SOP, however, may establish a different safe residual. Replacing an oxygen cylinder when the safe residual level is reached ensures that enough oxygen is available should an emergency medical problem occur.

3. Determine the available cylinder pressure by subtracting the safe residual from the cylinder pressure. For example, a cylinder with a pressure of 2000 psi has an available pressure of 1800 psi if the safe residual level is 200 psi (2000 - 200 = 1800 psi available pressure.)

4. Determine the conversion factor. Each type of oxygen cylinder employs a conversion factor based upon its size. For example, the "D" cylinder authorized for use in battalion aid stations has a conversion factor of 0.16. The conversion factors are:
   
   (a) "D" = 0.16
   (b) "E" = 0.28
   (c) "G" = 2.41
   (d) "H" & "K" = 3.14
   (e) "M" = 1.56

5. Determine the available liters by multiplying the available pressure by the conversion factor. For example, a "D" oxygen cylinder with an available pressure of 1800 psi has 288 liters of available oxygen (1800 x 0.16 = 288). Remember that the available liters do not include the oxygen that is still left in the cylinder when the safe residual level is reached.

6. Determine the flow rate. The flow rate is prescribed by the physician and expressed as liters per minute (lpm or l/m).

7. Determine the duration of flow by dividing the available liters by the flow rate. For example, a cylinder with 288 available liters of oxygen that is to be administered at a rate of 10 lpm will reach the safety level and need to be replaced by a new cylinder after 29 minutes (288 / 10 = 28.8; fractions of a minutes are rounded up or down, as appropriate).
e. **Apply the Nasal Prongs or Face Mask.**

   (1) **Nasal prongs.**

      (a) Place the tips of the prongs in the patient's nose.

      (b) Position the prongs so that the tips do not extend more than one inch (2.5 cm) into the nose.

      (c) Adjust the flow rate to the prescribed rate. A flow rate of one to six liters per minute should provide an inspired oxygen concentration of 22 to 35 percent, depending on the patient's breathing pattern.

      (d) Secure the headband or retaining strap so that it is comfortable for the patient and is sufficient to hold the apparatus in place.

      (e) Fasten the tubing to the pillow and bed clothing. Ensure that the tubing is secure and is not kinked or crimped.

   (2) **Face mask.** The patient who requires low, constant concentrations of oxygen and whose breathing pattern varies greatly may need to use the Venturi mask, especially if the patient is prone to retain carbon dioxide.

      (a) Obtain the proper size mask.

      (b) Before applying, hold the mask near the patient's face to show him how it and the retaining strap are to be placed.

      (c) Start the oxygen at the prescribed rate. This is done prior to the placement of the mask since the patient may be less apprehensive if he hears the oxygen coming through the mask.

      (d) Place the mask on the patient's face. Tell the patient to breathe naturally while you are adjusting the mask over his mouth and nose.

      (e) Adjust the headband or retaining strap so that it is comfortable for the patient and holds the mask securely in place.

f. **Position Patient.** Place the patient in the semi-Fowler’s position for ease of breathing.

g. **Record the Procedure on the Nursing Notes.** Record the time the treatment was initiated, the method used, the rate of flow, and the patient's response to treatment given.
h. Manage the Patient and Equipment at Regular Intervals.

   (1) Observe the patient for mental confusion, for disturbed unconsciousness, and for abnormal color. Check for any change in the patient's blood pressure and for increasing heart and respiratory rates.

   (2) Check the equipment. Make sure that the tubing connections are intact, the flow meter registers at the prescribed rate, and the nasal prongs or facemask is positioned properly. Check the water level in the humidifier and refill as needed. Change the cannula, humidifiers, tubing, and other equipment exposed to moisture on a daily basis. The equipment is changed daily because moisture can promote bacterial growth, thus rendering the equipment contaminated and creating conditions, which can cause infections.

3-8. SAFETY PRECAUTIONS ASSOCIATED WITH OXYGEN THERAPY

   a. Post "Oxygen" and "No Smoking" signs. These signs should be posted on the cylinder in use, in oxygen storage areas, and at entrances to a ward or room where oxygen is in use. The chief danger in using oxygen is fire. The pressure of oxygen in increased concentrations makes all materials more combustible. Things that burn slowly in ordinary air will burn violently and even explosively in the presence of increased oxygen.

   b. Inform the patient and visitors of the requirement for no smoking and no open flames in the room.

   c. Ensure that oil or grease is not used around the oxygen fittings. (Petroleum-based products will burn.)

   d. If an oxygen tank is used, secure it away from the door and high traffic areas to reduce potential unauthorized tampering of cylinder gauges and to reduce the possibility of the cylinder being knocked over and the valve being damaged or broken.

   e. Use only nonsparking wrenches on tanks.

   f. Ensure that all electrical equipment is properly grounded. If necessary, have medical maintenance personnel check electrical plugs and outlets.

   g. Avoid static-generating materials. Avoid nylon or other static-generating materials in uniforms, nightgowns, and pajamas. Do not use wool blankets on the bed since they also produce static.
h. When transporting a large oxygen cylinder, strap it to the carrier. If the oxygen cylinder is not secured, it may drop or fall. Upon falling, the weight of the cylinder may injure personnel or patients and damage equipment, walls, and flooring. The valve could possibly break off from the cylinder creating a high velocity missile (the cylinder) because of the suddenly released high pressure. A full oxygen cylinder has enough force to penetrate concrete walls.

Continue with Exercises
EXERCISES, LESSON 3

INSTRUCTIONS. Answer the following items by completing the statement or by writing the answer in the space provided at the end of the item.

After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. What is hypoxemia?

________________________________________________________________________

2. How is hypoxemia treated?

________________________________________________________________________

3. Name two ways in which oxygen is normally supplied.

________________________________________________________________________
________________________________________________________________________

4. What is the United States color code for oxygen tanks? The international color code?

________________________________________________________________________
________________________________________________________________________

5. How could the oxygen tank become an uncontrolled torpedo-like object?

________________________________________________________________________

6. Why is a cylinder regulator used when administering oxygen?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
7. A flow meter (or flow indicator gauge) is calibrated in ____________________.

8. Why is the humidifier used when administering oxygen?
   ________________________________________________________________
   ________________________________________________________________

9. How do you "crack" the cylinder?
   ________________________________________________________________
   ________________________________________________________________

10. Humidifiers and tubing should be changed at least every 24 hours or in accordance with the local SOP because:
    ________________________________________________________________
    ________________________________________________________________

11. Vacuum outlets may be located in the same area with the oxygen outlet. Oxygen outlets are color coded ________________ and vacuum outlets are color coded ____________________.

12. When you are attaching the flow meter to the wall unit (piped-in oxygen), why do you close or turn the flow adjusting valve of the flow meter to the OFF position?
    ________________________________________________________________
    ________________________________________________________________

13. Why must the facemask be used with caution?
    ________________________________________________________________
    ________________________________________________________________
14. What are the signs and symptoms of hyperventilation?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

15. How would you treat a person who is hyperventilating?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

16. When do you replace the oxygen cylinder with one that is full?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

17. The conversion factor for the "D" type cylinder is ________________.

18. A "M" cylinder is at 2100 psi. The safe residual level is 200 psi the rate of flow is 9 l/m. What is the duration of flow?

________________________________________________________________________

19. Position the nasal prongs in the patient's nose so that the tips do not extend more than ____________________________ into the nose.
20. You are checking on a patient who is being administered oxygen. What are some of the danger signs that indicate a problem?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

21. Use only ___________________________ wrenches on oxygen tanks.

22. Inform the patient and visitors of the requirement for __________________ and ___________________________ in the room while oxygen is being administered.

23. During oxygen therapy, do not use ____________________ blankets on the patient's bed.

Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 3

1. A low level of oxygen in the blood. (para 3-2)
2. By administering extra oxygen. (para 3-2b)
3. Oxygen tank (cylinder).
   Wall outlets (piped-in oxygen). (para 3-2b(1))
4. U.S. color code is green; the international color is white. (para 3-5c(1)(a))
5. If the valve is broken. (para 3-5c(1) Caution)
6. Used to reduce the high pressure in the cylinder to a low pressure that is safe for
   the casualty. (para 3-5c(3))
7. Liters per minute. (para 3-5c(3)(b))
8. It is used to add moisture to the oxygen to prevent drying and irritation of the
   patient's mucous membranes. (para 3-5c(4))
9. By quickly turning the cylinder handwheel (or wrench if a handwheel is not
   available) counterclockwise to open it slightly, listening for a loud hiss of escaping
   oxygen, and immediately turning it back clockwise to close it. (para 3-5e)
10. bacterial growth may occur. (para 3-7h(2)
11. oxygen: green; vacuum: yellow. (para 3-6)
12. To prevent damage to the gauge caused by a sudden influx of oxygen under
   pressure. (para 3-6f)
13. Patient may vomit and be unable to remove the mask to prevent aspiration of the
   stomach contents. (para 3-4b)
   Extreme anxiety and apprehension.
   Dizziness.
   Numbness of hands, fingers, toes, lips, and tongue.
   Healthy pink color to the skin.
   Stabbing chest pain.
   Flexed position of the hands with thumb curved toward the palms.
   Trembling and muscle cramping of the extremities. (para 3-3b(1)(a))
15. Reassure the casualty and encourage him to slow his breathing rate. Place a paper bag or other suitable item over his nose and mouth. Have him breathe into the bag and rebreathe the exhaled air, which has a high concentration of carbon dioxide. (para 3-3c(1)(b))

16. When the pressure gauge registers 200 psi (or the local SOP safe residual guideline). (paras 3-5c(1)(c), 3-7d(2))

17. 0.16. (para 3-7d(4)(a))

18. \[
\text{(Cylinder pressure—safe residual) x conversion factor} = \frac{\text{flow rate}}{9} \\
\frac{(2100-200)(1.56)}{9} x \frac{1900 x 1.56}{9} = \frac{2964}{9} = 329.3 \text{ minutes or 5 hours 29 minutes} \\
\]

(para 3-7d)

19. 1 inch (2.5cm). (para 3-7e(1)(b))

20. Mental confusion. 
   Disturbed unconsciousness. 
   Abnormal color. 
   Change in blood pressure. 
   Increasing heart rate. 
   Increased respiratory rate. (para 3-7h(1))

21. Nonsparking (para 3-8e)

22. No smoking, no open flames. (para 3-8b)

23. Wool (or static-generating). para 3-8g)

End of Lesson 3