UNIT 2
FLOWING WELL OPERATIONS

OPENING AND SHUTTING IN A WELL

1. The lease operator checks all surface equipment before opening a well.

   Damaged parts must be _____.

2. Leaking lines must be _____.

3. Surface valves must be properly set and in good running _____.

4. The burner of a line heater must be _____ before the well is opened.

5. Manufacturer's instructions are followed in firing up the heater's _____ and in checking the _____ level at the heater.

6. Safety valve pilots are inspected for condition and setting.

   While the well is shut in, a low-pressure pilot should have _____ the safety valve.

7. At wells with a low-pressure pilot, the valve may need to be held (open/closed) by hand while the well is being opened to flow.

8. If a surface safety valve has shut in the well, some part of the pilot may need to be _____ before the valve will operate again.

9. Surface vessels must be ready to receive the expected volume and pressure of fluid from the well.

   Lines and valves to surface vessels should be _____ and clear before the well is allowed to flow.

10. Surface chokes should be properly set.

    The flow bean in a positive choke should be the right _____ for the expected rate.

11. Sometimes, while the well is shut in, an adjustable choke is completely closed, or a rotary choke is set with a blank bean.

    Adjustable and rotary chokes may need to be _____ before the well is opened.

Opening the Well

12. If the master valve is opened *before* a wing or other downstream valve, flow through the master valve is (rapid and great/slow and slight).

13. Opening the master valve equalizes the pressure between the master valve and the next downstream _____ that is closed.

14. In opening a well, the master valve is opened (before/after) a wing or other downstream valve.

15. Opening the master valve rapidly throws well pressure on the next valve too suddenly.

    To prevent damage to the downstream valves and gages, the master valve is opened (slowly/rapidly).

16. It is first barely *cracked,* or opened just enough to equalize _____ to the next valve.

17. Escaping fluid makes a hissing sound.

    When the fluid no longer hisses through the valve, the pressure (has/has not) been equalized.

18. Then the master valve is _____ wide.

19. The operator checks the connections between the master valve and the next closed downstream valve.

    These connections must be pressure-tight, with no _____.

20. Oil leaks can be seen.

    A gas leak cannot always be seen, but you can usually hear the _____ of escaping gas.

21. Then the operator cracks the next (upstream/downstream) valve that is closed.

22. Usually this will be a _____ valve.

23. Some wells do not have wing valves.

    Then a surface _____ valve may be closed manually to shut in the well.

24. Or it may be an adjustable or rotary _____ that is used to stop flow.

25. The procedure for opening all the valves is first to barely _____ the valve until pressure is equalized.

26. Then, when flow through a valve stops, the valve is _____ wide.

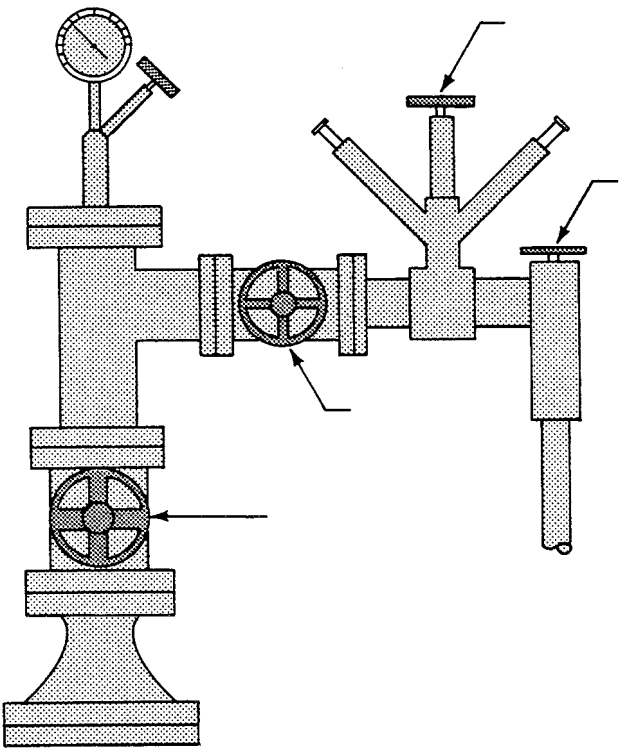
27. If the well has been shut in by closing an adjustable choke, the choke is not opened wide after pressures equalize.

    The adjustable choke must be slowly opened to the desired _____.

28. An adjustable choke that is hard to regulate is not used to shut the well in.

    A positive choke (can/can never) be used to shut the well in.

29. Assuming these valves and the adjustable choke are closed, number them in the order that you would open them to open the well.



30. Suppose the Christmas tree is a cross instead of a tee.

    Then, after opening the first wing valve, you (would/would not) want to open that line all the way to the choke.

31. You would open the first wing valve and then the second _____ valve when the flow line is a cross.

32. Then you would continue opening the valves alternately until both lines are fully opened.

    This way, the time that one choke must carry the full flow from the well is (increased/decreased).

33. This reduces _____ on the choke.

34. After the lines are opened, the surface safety valve is adjusted to its (automatic/manual) control setting.

35. The well is now _____.

36. To read the tubing pressure gage, the operator must open the _____ _____ at the top of the Christmas tree.

37. After reading and recording the tubing pressure, the operator may _____ the valve again to protect the gage.

Shutting in the Well

38. The procedure for shutting in a well is the opposite of the procedure for opening a well.

    In shutting in a well, the master valve is closed (first/last).

39. This is to prevent _____ on the master valve.

40. In opening a well, the valves are opened (slowly/rapidly) to bleed off pressure.

41. Valves are closed as rapidly as possible in shutting in a well.

    This is because the valves are being closed against a rapidly _____ fluid.

42. Closing a valve slowly would be like pinching down a garden hose.

    The *velocity* of flow through the partially closed valve would (increase/decrease).

43. Wear on the valve would (increase/decrease).

44. To protect the plugging device in the valve, surface valves are closed as (slowly/rapidly) as possible.

45. This prevents erosion of the gate, ball, or plug caused by high fluid (pressure/velocity).

46. Usually, at least two valves, or a valve and a choke, are used to shut in the well.

    If a wing valve is used, the wing valve is closed (first/last).

47. Then, after pressures have equalized, the master valve is closed (slowly/rapidly).

48. If there is no wing valve, a surface _____ valve or a surface _____ may be used to shut in the well.

49. (Positive/Rotary/Adjustable) chokes *cannot* be used to shut in the well.

50. Or, to shut in a well:

    close the _____ valve, *or*

    close a _____ valve, *or*

    close an _____ or a _____ choke;

    then, close the _____ valve.

51. The master valve must always be either fully _____ or fully _____ while the well is open or shut in.

52. A partially open valve _____ too fast at the gate, ball, or plug.

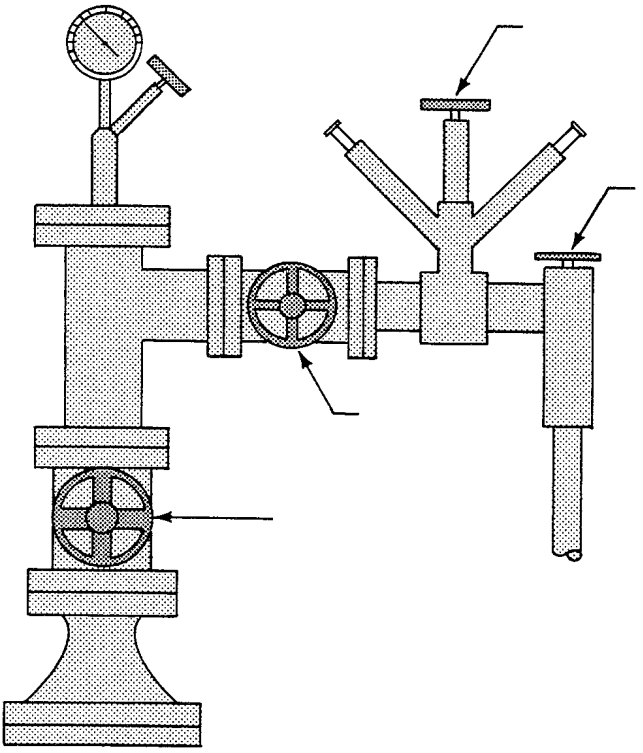
53. To protect the master valve even more, some wells are shut in with *three* valves.

    Then an adjustable or rotary choke, or a surface _____ valve, is the first valve closed.

54. When three valves are used, the second valve closed is the (wing/master) valve.

55. Then the _____ valve is closed (rapidly/slowly).

56. Number these four handwheels in the order you would turn them to shut in a well.



57. Or, in *opening* the well,

    the master valve is cracked (first/last), and

    the valves are opened as (slowly/rapidly) as possible.

58. In *shutting in* a well,

    the master valve is closed (first/last), and

    the valves are closed as (slowly/rapidly) as possible.

59. Some valves and most adjustable chokes have rising stem indicators to show how far the valve or choke is _____.

60. When there is no rising stem indicator, you must try the _____ to tell if the valve is opened or closed.

61. The operator must make sure the valves on each well are either fully _____ or fully _____.

62. A partially opened surface valve _____ out quickly.

Other Methods of Stopping Production

63. A well is *shut in* by closing (surface/subsurface) valves.

64. To repair a surface choke, or to adjust a positive surface choke, you must:

    ____ shut in the well.
    ____ install a tubing plug.
    ____ kill the well.

65. A master valve is usually repaired by installing a _____ _____.

66. Tubing plugs are (surface/wireline) equipment.

67. A tubing plug would usually be run and removed by a _____ crew.

68. Suppose tubing is being repaired.

    Then the well must be _____ by pumping heavy fluids into the well-bore.

69. Shutting in a well, installing _____ plugs and valves, and killing the well are all ways of _____ production from the well.

70. Usually, the operator _____ _____ the well to stop production.

71. Special crews and equipment are usually needed to install _____ plugs or to _____ the well.

72. Diesel oil, salt water, or drilling fluid is used to kill a well.

    The liquid chosen must create a high enough hydrostatic bottom-hole pressure to _____ flow.

73. When hydrostatic bottom-hole pressures balance reservoir pressure at the sand face, flow into the well-bore _____.

74. In wells with a packer, the killing liquid is pumped into the (tubing/casing) only.

75. Fluid is pumped into the tubing through the _____ adapter.

76. In wells without a packer, some of this liquid will rise up in the _____.

77. Fluid can also be pumped directly into the annulus through the outlets on the _____ head.

78. Fluid is forced into the annulus only in wells that (have/do not have) a packer.

79. In unpacked wells, company policy or preference decide whether the killing liquid is pumped down the tubing or is injected into the _____.

80. If tubing is pulled after the well has been killed, additional killing liquid must be pumped in as the tubing string is removed.

    The additional liquid makes up for the volume that was occupied by the _____.

81. The well cannot flow as long as the well-bore pressure is kept (higher/lower) than the pressure from the reservoir.

Swabbing

82. After a well is killed, the fluid must be removed before the well can flow again.

    Swabbing is one method of removing killing _____ from the well-bore.

83. During drilling, heavy drilling muds are circulated through the well-bore.

    Before a new well is opened, these drilling muds are removed, usually by _____.

84. Sometimes a well that dies when the well-bore loads up with water can be brought to life again by _____.

85. In swabbing a well, heavy fluids are _____ through the tubing string.

86. Swabbing tools are run in the tubing on a _____ _____.

87. The fluid is swabbed out by a _____ crew.

88. For wireline operations, the needle valve and gage are removed from the treetop _____.

89. The operator shuts in the well before wireline operations begin.

    In shutting in the well, he may need to bleed off the _____ between the surface valves.

90. Surface equipment must be set to accommodate the large liquid *slugs* lifted by the swabbing tools.

    Surface chokes are changed to a (larger/smaller) size before swabbing begins.

91. After the well is swabbed back to life and normal flow begins, a (smaller/larger) choke size is needed.

92. Before the wireline crew arrives, the lease operator needs to look at his records.

    The wireline crew will need to know the depth and ID of the _____ string.

93. They will need to know the total depth of the _____.

94. They will need to know the kinds of subsurface equipment installed and the _____ at which these are set.

95. They will need to know if a _____ is set in tension or compression, and whether a bottom-hole choke or _____ is installed.

96. The operator should be able to find all the information needed in his well _____.

97. Installing the lubricator and swabbing the well is usually done by a wireline crew.

    After the well is fully flowing again, the (wireline crew/ lease operator) adjusts the choke.

Review

98. A well is *shut in* by closing valves in the _____ _____.

99. Flow also may be stopped by inserting a valve in the _____ head or a plug in the _____.

100. Or the well may be *killed* by forcing oil, _____, or drilling _____ into the well-bore.

101. The killing liquid increases hydrostatic bottom-hole pressures enough to prevent flow from the _____ into the _____-_____.

102. A well is shut in to make repairs (upstream/downstream) from the master valve.

103. A tubing plug is used when the _____ _____ is being repaired.

104. To pull tubing, the well is _____.

105. To change a choke bean, the well is _____ _____.

106. Before wireline operations, the well is _____ _____.

107. In selecting subsurface equipment, wireline-run equipment is often preferred because the well does not have to be _____ to pull the equipment.

108. To pull and repair tubing-run equipment, the well must be _____.

109. A well is swabbed out to bring it to _____ again.

STOP-COCKING

110. As production continues from a flowing well, reservoir pressure gradually (rises/falls).

111. When pressure in the reservoir near the sand face is low enough to equal the well-bore pressure, the well _____ flowing.

112. Sometimes an apparently dead well may be returned to flow by *stop-cocking.*

Stop-cocking is periodically shutting in a well and then opening it again after _____ has built up at the sand face.

113. When the well is opened again, the pressure decreases all the way up the tubing, and released gas _____ in the tubing.

114. This gas begins to lift _____ to the surface again.

115. A stop-cocked well produces by heads.

A heading well produces (continuously/intermittently).

116. In stop-cocking a well, normal procedures for shutting in and opening a well are followed.

The well is shut in by closing first the (wing/master) valve, and then the _____ valve.

117. The valves are closed (rapidly/slowly) to prevent erosion of the gate or plug.

118. While the well is shut in, fluid continues to flow toward the well-bore.

Reservoir pressure at the sand face (increases/decreases).

119. The well must be shut in long enough for the pressure at the sand face to become (greater/smaller) than well-bore pressures.

120. Then, the well is opened, and production begins.

The well is opened by first opening the (wing/master) valve and then the _____ valve.

121. The valves are opened _____ to protect the downstream valves.

122. In a well with a packer, reservoir fluid is confined to the _____.

123. When the well is opened, gas expanding in the tubing _____ the heavier fluids to the surface lines.

124. When all the gas has left the tubing, flow _____ again.

125. Then the well is _____ _____ again.

126. In a well without a packer, high-pressure gas in the annulus can *blow around* into the _____.

127. Then the time of heading is the time needed for blow-around _____ to empty the _____ of fluids.

128. Most heading wells follow a regular pattern.

The time needed for reservoir pressure to build to a head is (about the same/very different) from head to head in a well.

129. The length of time the head lasts is about the _____ in the same well.

130. Heading patterns can be timed by recording changes in tubing pressure.

Tubing pressure (rises/falls) during a head.

131. Stop-cocking is timed to follow the heading _____ of the well.

132. In an unpacked well, _____ pressures also show heading patterns.

133. Sometimes, a well that is stop-cocked for a while begins to _____ continuously again.

134. When stop-cocking must continue for a long time, an *intermitter* is used to open and close the well (manually/automatically).

135. When an intermitter is installed at a well that is already heading, it must be _____ to match the well's natural rhythm of heading.

136. Some intermitters also may be set to respond automatically to changes in tubing or casing _____.

137. A well is stop-cocked to (increase/decrease) the reservoir pressure at the sand face.

138. Sometimes, an apparently dying well may be made to produce strongly again by _____-_____.

139. For stop-cocking to be economical, the gain in recovery must be much greater than the _____ of production during shut-in.

140. Stop-cocking may be used on a strongly flowing well.

Some strongly flowing wells produce more than the allowable.

Then, the well may be stop-cocked to limit _____.

141. When possible, it is better to limit production by (stop-cocking/choking).

EQUALIZING A WELL TO RETURN IT TO FLOW

142. Sometimes, slow flow and slippage build up a long column of fluids in the tubing.

The fluids built up from slippage contain little or no (oil/gas/water).

143. Such a column of fluid has a (high/low) density and creates (high/low) hydrostatic bottom-hole pressures.

144. When hydrostatic bottom-hole pressure balances the reservoir pressure at the sand face, flow _____.

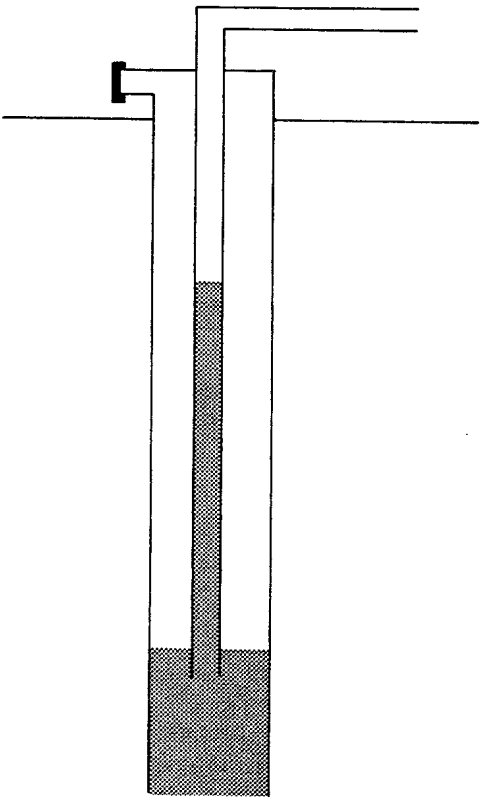
145. The well is apparently dead.

But reservoir pressures may still be high enough to allow a (high/low) -density fluid to flow through the tubing.

146. Once the tubing is cleared of heavy fluids, the well may begin to _____ again.

147. It will flow if the reservoir fluid still contains enough _____ to create a low enough hydrostatic pressure in the well-bore.

148. Here is a well that can be equalized to bring it back into production.



The flow line is (open/closed) at the surface.

149. The outlets in the tubing head are _____.

150. There (is a/is no) packer between the tubing and casing.

151. Fluid (can/cannot) flow freely between the tubing and annulus.

152. But there is no flow.

Tubing pressure and casing pressure are (the same/different) at well bottom.

153. The *liquid levels* in the tubing and annulus are (the same/different).

154. There is a higher column of liquid in the (tubing/annulus).

155. Since bottom-hole pressures are equal, there must be high-pressure _____ above the liquid in the annulus.

156. The difference between the liquid levels in the tubing and casing is balanced by the pressure of the _____ trapped in the annulus.

157. At the well head, pressure in the annulus is registered on the _____ pressure gage.

158. In a well that can be equalized, this gage shows a (high/low) pressure.

159. The flow-line pressure is recorded on the _____ pressure gage.

160. This gage is on the (tubing head/treetop).

161. Since the well is open and not flowing, the tubing pressure is (high/low).

162. In a well that can be equalized:

the casing valve is (open/closed);

casing pressure is (high/low);

the master valve is (open/closed);

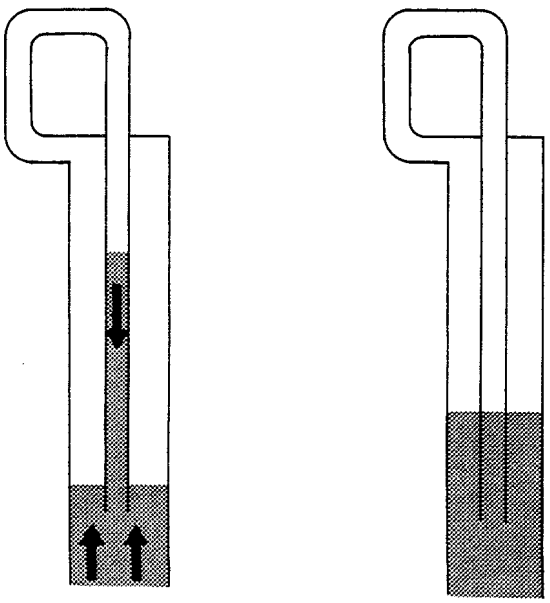
tubing pressure is (high/low).

163. The well is equalized through a *U-tube* that connects the treetop adapter to the tubing head outlet.

The U-tube permits flow between the _____ and and the _____ at the top of the well.

164. High-pressure gas from the _____ flows into the _____ until pressures equalize at the top of the well.

165. Here is what happens as the pressures equalize.



The liquid level in the annulus (rises/falls), and the liquid level in the tubing (rises/falls).

Equalizing continues until the liquid levels in the tubing and annulus are _____ _____.

166. At this point, tubing pressure and casing pressure are (the same/different).

167. Now the valve at the tubing head is closed, and the flow-line valves are opened.

High-pressure gas in the _____ leaves through the flow line.

168. High-pressure gas is still trapped in the _____.

169. As the gas leaves the tubing, the pressure at the bottom of the tubing (increases/decreases).

170. The gas left in the annulus forces more _____ into the tubing.

171. But the liquid level in the tubing is still _____ than before the well was equalized.

172. Hydrostatic bottom-hole pressures are _____. lo

173. The well may start to _____ again. fl

174. Usually, a well must be equalized several times before it begins to flow.

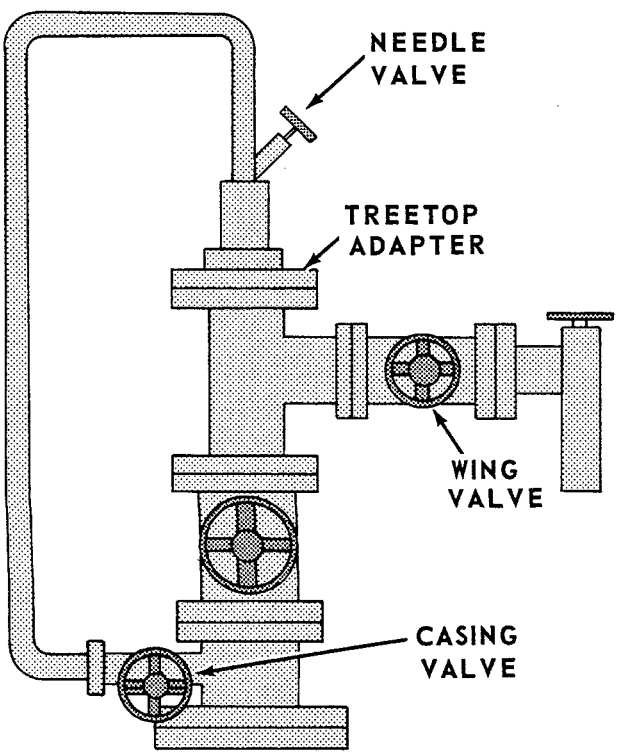
Each time, some gas enters the well-bore from the reservoir.

The gas (increases/decreases) hydrostatic pressures in the well-bore. de

175. Eventually, hydrostatic bottom-hole pressures are _____ enough to permit continuous flow. lo

176. Since the process must usually be repeated several times, the U-tube is left installed at the Christmas tree until _____ has begun. fl

177. Here is the way a U-tube is installed.



One end of the flexible tube or hose is connected to the closed _____ valve. c

178. The other end fits on the _____ _____ in the Christmas tree.

179. The connection is made while the wing valve, the master valve, and the casing valve are all _____.

180. After the connection is made, these valves are opened slowly:

the _____ valve,
the _____ valve, and
the _____ valve.

181. The _____ valve is left closed to conserve well pressures.

182. Wear on the master valve is reduced by cracking it (before/after) the casing valve is cracked open.

183. When _____ across the master valve has equalized, the valve is opened wide.

184. Then the needle valve is opened and the _____ valve is cracked slowly.

185. With all three valves open, gas flows through the U-tube from the _____ valve into the _____.

186. Tubing pressure (increases/decreases).

187. Casing pressure _____.

188. When tubing-annulus pressures have equalized, the sound of rushing gas _____.

189. Then the (casing/master) valve is closed rapidly.

190. And the needle valve and _____ valve are closed (slowly/rapidly).

191. To give the well the best chance to flow, a (larger/smaller) choke size is installed.

192. Then the (master/wing) valve is cracked until pressures equalize.

193. Finally, the _____ valve is cracked and fully opened and high pressure _____ flows from the tubing.

194. The well flows continuously when equalizing reduces _____ pressures enough.

195. After flow has started, a (larger/smaller) choke size may need to be installed.

REVIEW AND SUMMARY

196. Normally, wells are opened by opening two or more _____ valves.

197. The master valve is always opened (first/last) and closed (first/last).

198. Valves are opened (slowly/rapidly).

199. Valves are closed _____.

200. If the tubing has been plugged, or a tubing valve has been set in the tubing head, the valve or plug must be _____ before the well is opened to flow.

201. Removing a *tubing valve* requires a special installing tool.

Pulling a tubing *plug* is a _____ operation.

202. If a well has been killed, it must be _____ _____ before it can flow again.

203. Swabbing (is/is not) a wireline operation.

204. A new well may be swabbed to remove the muds used in _____ the well.

205. A slow-flowing well may be swabbed to remove heavy _____ accumulated through slippage.

206. Stop-cocking is manually opening and shutting in a well to increase production during _____.

207. An intermitter is used for automatic:

_____ equalizing.
_____ stop-cocking.

208. Equalizing is connecting the _____ and the _____ at the well head to equalize pressures.

209. Apparently dead wells may be brought back to life by equalizing:

if there is no _____ in the well;

if _____ pressure is high; and

if _____ pressure is low.

210. Equalizing causes flow by (increasing/decreasing) hydrostatic bottom-hole pressures.

211. Another way of increasing production from a weakly flowing well is to use a (larger/smaller) size choke.

212. In some wells, a bottom-hole choke or regulator is used to release gas (high/low) in the tubing.

213. The pressure drop at the choke increases the lifting power of the _____ in the tubing.