

Master Watchmaking

MODERN SHOP METHODS

LESSON

35

Problems and Solutions

Questions and Answers Illustrated

CHICAGO SCHOOL OF WATCHMAKING

Founded 1908 by THOMAS B. SWEAZEY

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WHEN IS A MAN A WATCHMAKER?

Time and time again we read or hear the definition of a watchmaker. It is said by some that a man must have years of experience behind him. Some states require a watchmaker to pass an examination, and upon meeting their requirements, will issue a certificate to that effect. Certain associations have set up a standard by which the aspiring watchmaker can take an examination and upon paying a fee be issued a certificate stating in large captions that he is a watchmaker. Schools issue diplomas stating that the recipient has completed his course in a satisfactory manner. Men who learned their trade in the old country declare that the best watchmakers come from the particular country in which they were apprenticed. Some state that a good watchmaker must have an electric timing device and only then can he be a good watchmaker. There are always those who will condemn something or other whether or not they are qualified to do so. Many so-called eminent watchmakers who a few years back condemned watch cleaning machines now regard them as a valuable asset to their shops.

Without much doubt it can be said that because of lack of educational facilities, watchmaking or watch repairing has not progressed as rapidly as it should have. The watchmaker must meet the problems of the future as soon as they are presented. He must be alive to new ideas. He must be on the

lookout for new tools that will help him do a better job. He must not become "old fashioned." He must strive to do better work -- not strive to see how much he can "get away with." He should put himself in his customers' place and treat them accordingly. He should do everything possible to elevate himself and his associates. His pay should rank with that of the highest tradesmen. In short, a watchmaker is one who can conscientiously turn out a first class job with a personal feeling of a job well done. His success will depend upon his desire to be of service to his customers and an asset to his community.

To meet the conditions which prevail in some states and for those who are desirous of taking an outside horology examination, this review of your elementary training in watchmaking is put in the form of questions and answers. One of the best ways to cram for an examination is to write out each question several times and then write the answer several more times. This is the most effective method for the majority of the students. The majority of the following questions are similar to those given by state boards and other associations which have written test questions. Although some of the answers given may conflict with the opinions of others, they are, in most cases, generally accepted for written examinations.

QUESTION

ANSWER

1. To avoid fingerprints on the movement or dial we ?

2. Is it necessary to oil the stem on a pocket watch case and, if so, at what point?



3. What is the difference between an open face movement and a hunting movement?

4. Give the name used in horology which describes the series of gears and which transmits the power from the mainspring to the pallets.

5. What material are pinions made from?

6. What controls the rate of a timepiece through the regularity of its oscillations?

7. How many revolutions does the center wheel and pinion make in an hour?

1-A. Handle the movement by the edge of the pillar plate and use watch paper.

2-A. It is advisable to oil the stem at the point of contact with the sleeve.

3-A. An open face winds at 12; a hunting winds at 3.

4-A. Train.

5-A. Steel.

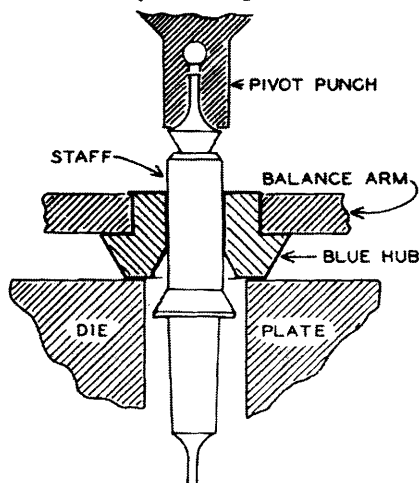
6-A. The balance assembly.

7-A. One.

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| 8. How many revolutions does the fourth wheel and pinion make in one hour? | 8-A. Sixty. |
| 9. What is the minimum number of steady pins found on each bridge? | 9-A. Two. |
| 10. How many hours should an average watch run with one winding? | 10-A. 32 to 36. |
| 11. Is the metric or the Dennison Gauge the more accurate for measuring the width and strength of a mainspring? | 11-A. The metric. |
| 12. To get the best results of the area between the outside of the arbor and the inside shell of the barrel how much of the area should be occupied by a mainspring with 11 coils? | 12-A. One half. |
| 13. How much should be occupied by one with 13 coils? | 13-A. One half. |
| 14. The Metric Micrometer gives us readings in..? | 14-A. 1/100 of a millimeter. |
| 15. What is the purpose of the clutch lever? | 15-A. To move the clutch from winding to setting. |
| 16. Will a 7 Jewel and a 21 Jewel watch of the same size and model require mainsprings of different strength? | 16-A. Yes. |
| 17. Name the jewels in a 17 Jewel Watch which are not used as bearings for a wheel and pinion? | 17-A. R. Stone (Receiving Stone)
L. Stone (Let-Off Stone)
Roller Jewel |
| 18. What is the advantage of an olive hole jewel? | 18-A. It has a smaller bearing surface. |

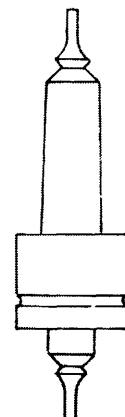


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| 19. What does the term "genuine" watch material mean? | 19-A. The material was made by the factory that made the watch. |
| 20. How do you recognize a Waltham friction staff? | 20-A. By the blued hub on the balance wheel. |



21. Some Hamilton watches use another type of friction balance staff which may be recognized by

21-A. A groove cut in the staff.



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| 22. The main purpose of truing and poising the balance wheel is ? | 22-A. To be able to properly adjust and bring the watch to time. |
| 23. The balance screws in a compensating balance wheel have been placed in their respective positions by the factory for ? | 23-A. Temperature adjustment. |
| 24. What is the general cause of a balance wheel which seems to run true in the caliper but not in the watch? | 24-A. Most likely the pivots are bent. |
| 25. In poising a balance wheel, would you generally remove or add weight if the regulator was as far toward the "fast" as possible? | 25-A. More weight is removed than added. |
| 26. Is it practical to do watch repairing without a lathe? | 26-A. No. |
| 27. The word Isochronism means? | 27-A. Equality of time. |
| 28. How many impulses does the pallet receive from an escape wheel with 15 teeth in 1 revolution? | 28-A. 30. |
| 29. What is the proper way to put a mainspring in a barrel? | 29-A. With a mainspring winder. |
| 30. How much space should a mainspring occupy in the barrel? | 30-A. One half the remaining area with the barrel arbor in place. |
| 31. Name the three kinds of barrels used in watches. | 31-A. Motor Barrel; Going Barrel; Fuzee Barrel. |
| 32. If a barrel has 80 teeth and the Center Pinion has 10 leaves, how many revolutions does the barrel make in 24 hours? | 32-A. Three revolutions. |

SOLUTION:

Teeth in barrel divided by leaves in center pinion equals time for 1 turn of barrel.

Substituting, $\frac{80}{10}$ equals 8

Hours watch runs divided by time for 1 turn of barrel equals number of turns of barrel.

Substituting, $\frac{24}{8}$ equals 3

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| 33. What is the effect of putting a mainspring in a watch that is: | 33-A. |
| A. Too thick? | A. It will exert an excess of power. |
| B. Too thin? | B. It will not have enough power. |
| C. Too wide? | C. It will cause friction between the barrel cap and the bottom of the barrel. |
| D. Too narrow? | D. It may cause buckling and will lack power. |

E. Too short?

E. It would not run a sufficient length of time.

F. Too long?

F. It would not run a sufficient length of time.

34. How many coils would you ordinarily find in the barrel if the mainspring is the proper length and strength?

34-A. Twelve.

35. Name the different kinds of end fastenings found on mainsprings.

35-A. (A) T-End, (B) Double Brace, (C) Tongue, (D) Hole, (E) Bridle; Slip Spring; or Tension Spring



A



B



C



D



E

36. What is a Motor Barrel?

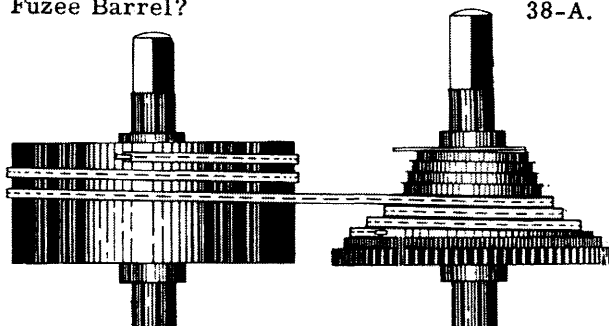
36-A. A Motor Barrel remains stationary. Its only purpose is to confine the mainspring. The great wheel, or first wheel, revolves independent of the barrel.

37. What is a Going Barrel?

36-A. The Going Barrel contains the teeth of the great wheel or first wheel and revolves as it drives the train.

38. What is a Fuzee Barrel?

38-A. A barrel which contains the mainspring and upon which the fuzee chain winds as the watch runs down.

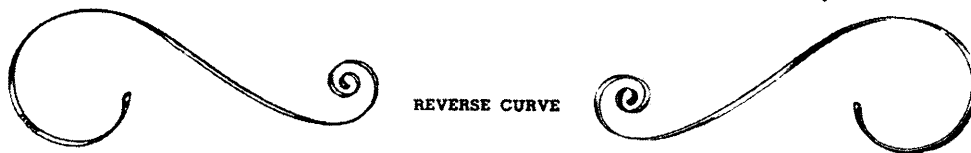


39. What is a Suspended Barrel?

39-A. A Suspended Barrel is one which is supported only from the upper plate.

40. What is a reversed curve mainspring?

40-A. A spring which is reversed to the direction which it is wound. It does not have a tendency to set as quickly and it possesses greater elasticity.



REVERSE CURVE

41. What is a cross curve mainspring?

41-A. One with a concave surface.

42. If a barrel head is loose, how do you tighten it?

42-A. With a barrel contractor.

43. What are the safeguards used when winding in a mainspring?

43-A. Clean the new mainspring thoroughly to dissolve the protective coating. Dry carefully. Oil lightly by passing spring through

tissue with small amount of oil. Wind spring in with a mainspring winder. Use an arbor of the proper size, make certain that the pin on the winding arbor isn't any longer than the thickness of the mainspring. Insert mainspring in barrel and oil with watch or clock oil.

44. How would you fit a new hook in a barrel Explain. 44-A. Locate center from barrel head shoulder to bottom of barrel on the outside of barrel. Drill hole proper size and tap. Then take piece of brass wire slightly tapered and thread with same size die from which tap was made. Screw into barrel the proper amount after which cut off on the outside and finish flush with barrel. File slot on the proper side of the hook.
45. What risks would you take by not removing the mainspring every time you clean a watch? 45-A. The cleaning fluid would probably ruin the mainspring. The cleaning fluid would also ruin the lubricating properties of the oil.
46. How do you determine the strength of a mainspring? 46-A. The strength of the mainspring may be determined by dividing the inside diameter of the barrel by 100. For very small watches add 1/100th of a millimeter.
47. What is the ratio of the center wheel to the third pinion? 47-A. 8 to 1.

SOLUTION:

$$\frac{\text{Number of teeth in 3rd wheel}}{\text{Number of leaves in 4th pinion}}$$

Substituting: $\frac{80}{10}$ equals 8 Ratio is 8 to 1

48. What is the ratio of the 3rd wheel to the 4th pinion? 48-A. 7-1/2 to 1

SOLUTION:

$$\frac{\text{Number of teeth in 3rd wheel}}{\text{Number of leaves in 4th pinion}}$$

Substituting: $\frac{60}{8}$ equals 7-1/2 Ratio is 7-1/2 to 1

49. What is the ratio of the center wheel to the 4th pinion? 49-A. 60 to 1.

SOLUTION:

$$\frac{\text{Number of teeth in center wheel X number teeth in 3rd wheel}}{\text{Number of leaves in 3rd pinion X number of leaves in 4th pinion}}$$

Substituting: $\frac{80 \times 60}{10 \times 8}$ equals 60 Ratio is 60 to 1

50. What is the time of one revolution of the third wheel?

50-A. 7-1/2 minutes.

SOLUTION:

$$\frac{\text{Number teeth 3rd wheel}}{\text{Number leaves 4th pinion}} \times \text{Number turns 4th pinion makes in 1 minute}$$

51. Name five different kinds of trains.

51-A. Slow..... 14,400 vibrations per hour
 Medium..... 16,200 " " "
 Fast..... 18,000 " " "
 Quick..... 19,800 " " "
 Extra Quick..... 21,600 " " "

52. How do you calculate the number of vibrations a watch with a second hand makes in one minute?

52-A. The number of teeth in the 4th wheel multiplied by twice the number of teeth in the escape wheel, divided by the number of leaves in the escape pinion.

EXAMPLE:

$$\frac{60 \times 30}{6} \text{ equals 300 vibrations per minute}$$

53. What is usually meant by a quick train watch?

53-A. Two Common Quick Train Watches are 19,800 vibrations and 21,600 vibrations per hour.

54. What is the purpose of a safety pinion on the center staff of some watches?

54-A. The Safety Pinion will unscrew when the mainspring breaks, thereby relieving the train of the excess strain.



55. What is the center staff?

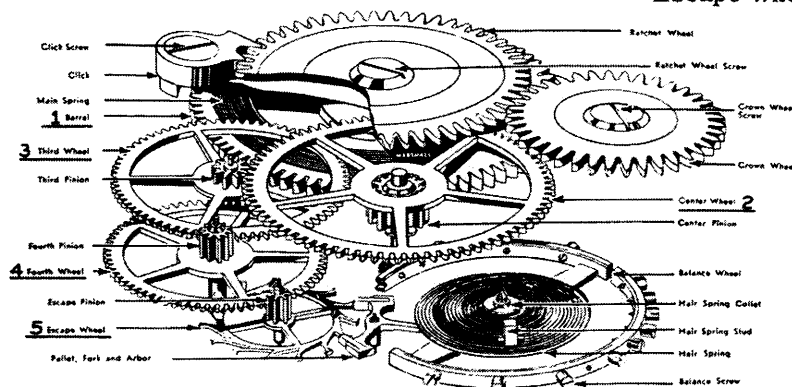
55-A. The arbor attached to the center wheel, which carries the minute hand.

56. If you had a train wheel that was out of round, how could you correct it?

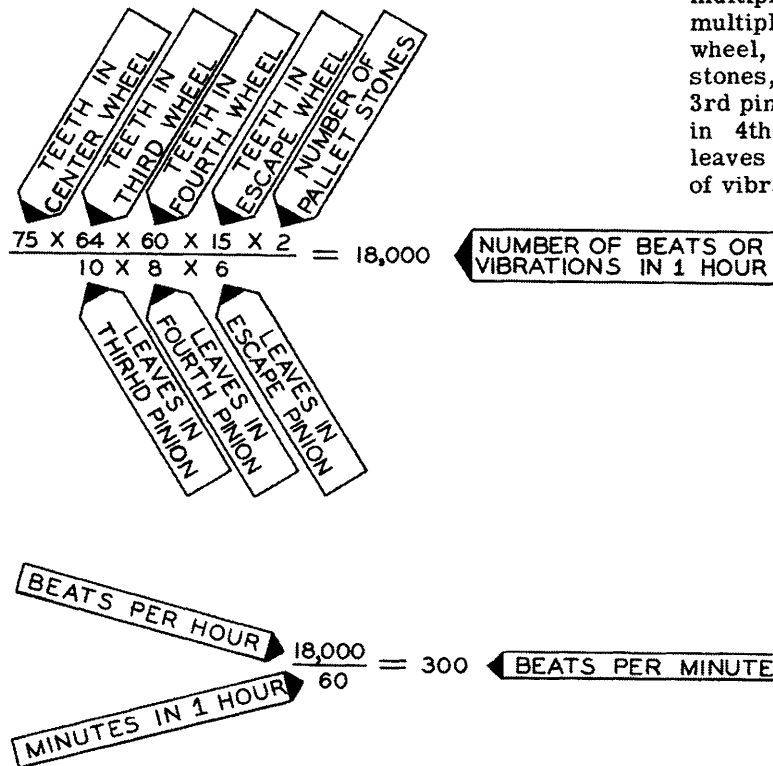
56-A. The wheel must be recentered usually by cementing to a cement chuck and then re-bushed, or it may be corrected with a rounding up tool.

57. Name the wheels in a watch train.

57-A. Barrel, No. 1; Center Wheel, No. 2; Third Wheel, No. 3; Fourth Wheel, No. 4; and Escape Wheel, No. 5.



58. How do you calculate the train of a watch?



58-A. The number of teeth in the center wheel, multiplied by number of teeth in 3rd wheel, multiplied by number of teeth in 4th wheel, multiplied by number of teeth in escape wheel, multiplied by number of pallet stones, DIVIDED BY number of leaves in 3rd pinion, multiplied by number of leaves in 4th pinion, multiplied by number of leaves in 5th pinion, EQUALS the number of vibrations or beats per hour.

59. How do you figure a Quick Train?

59-A. All trains are calculated in the manner shown in the answer and question #58. Because of the different ratio between the center wheel and 4th wheel the number of vibrations can be other than 300 vibrations per minute.

EXAMPLE:

$$\frac{64 \times 66 \times 60 \times 15 \times 2}{8 \times 8 \times 6} \text{ equals } 19,8000$$

60. How do you figure on Extra Quick Train?

60-A. At times you will find a watch train with an additional train wheel and pinion. Do not let this confuse you but in figuring the number of vibrations place the number of teeth in the extra wheel and the number of leaves in the pinion in proper sequence.

EXAMPLE:

$$\frac{42 \times 42 \times 35 \times 35 \times 12 \times 2}{7 \times 7 \times 7 \times 7} \text{ equals } 21,600$$

61. How do you tighten the cannon pinion friction on a watch with a Center Pin?

61-A. By driving the cannon pinion against the end of the center pinion pivot.

62. What causes an ordinary Cannon Pinion to stay in place?

62-A. Usually a small depression in center staff, into which the center punch mark or spring snaps in place.

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| 63. Do you oil a Cannon Pinion? | 63-A. Yes, sparingly. |
| 64. How much friction is considered necessary for the Cannon Pinion? | 64-A. Sufficient to carry the hands safely. |
| 65. If a Cannon Pinion works up slightly when setting a watch, what can you do? | 65-A. Set center punch mark up higher on the cannon pinion. |
| 66. What direction do you turn the dial screws when releasing most Swiss Dials? | 66-A. To the right. |
| 67. What is the proper way to center a dial if the holes do not center with cannon pinion and second bit?
Should the balance be taken out? | 67-A. Place a piece of wood against the edge of the dial and tap the edge.

The balance should be taken out. |
| 68. If a watch continues to run and the hands do not move, what might be the trouble and how would you remedy same? | 68-A. The trouble might be a loose cannon pinion. Tighten the Cannon Pinion. |
| 69. Name the Dial Train. | 69-A. Hour wheel, minute wheel, cannon pinion, minute pinion. |
| 70. How do you tighten a loose cannon pinion? | 70-A. Use a Cannon Pinion tightener, or insert tapered brass wire into cannon pinion and use center punch. |
| 71. What is the Hour Wheel? | 71-A. The Hour Wheel is the wheel which turns on the cannon pinion once every 12 hours and carries the hour hand. |
| 72. What is a Minute Wheel? | 72-A. A wheel and pinion used to give the ratio 12 to 1 between the cannon pinion and the hour wheel. |
| 73. What is the purpose of a dial washer? | 73-A. The purpose of a dial washer is to hold the hour wheel in the proper position. |
| 74. If a watch stops every 12 hours, where would you look for the trouble? | 74-A. Examine the Hour Wheel. |
| 75. How many revolutions does the ordinary escape wheel make per minute? | 75-A. Ten. |

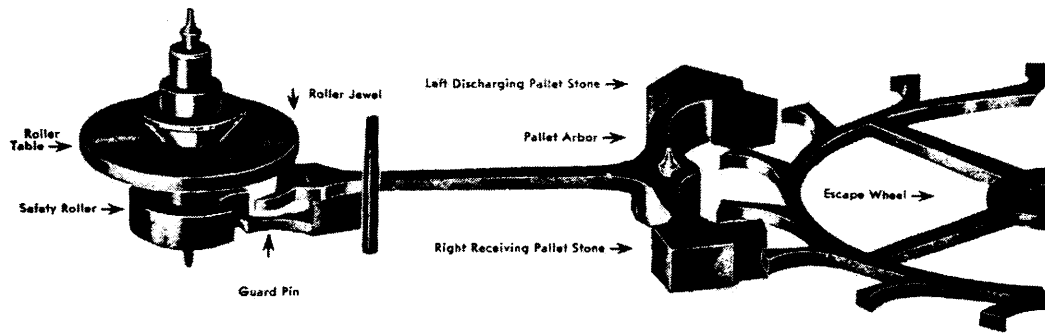
EXAMPLE:

Teeth in 4th Wheel
Leaves in 5th Pinion X turns 4th wheel makes in 1 minute

SUBSTITUTING:

$\frac{60 \times 1}{6}$ equals 10

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| 76. Name the main group of parts of which the escapement consists. | 76-A. Escape wheel and pinion; pallets; fork; roller; roller jewel. |
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77. How do you put an Escapement in beat?
77-A. By turning the hairspring collet until the balance escapes with equal ease on both sides or assuming that the watch is in line, bring the roller jewel to the line of center and then place hairspring in the proper position.
78. Why are the locking faces of the pallet stones placed at an angle?
78-A. To produce draw.
79. If an escapement has too much lock and slide, how do you correct it?
79-A. By pushing the pallet stone in and closing the banking pins.
80. What is meant by lock and slide?
80-A. Lock is the distance from the locking corner that the tooth drops on the pallet stone. Slide is the movement of the pallets after the lock.
81. For what purpose are the bankings in a watch?
81-A. To regulate the amount of angular motion to the Lever.
82. Name the pallet stones in a watch.
82-A. R meaning the Receiving and L the Let-Off.
83. What is meant by Corner Clearance?
83-A. The freedom between the horn of the fork at the fork slot and the face of the roller jewel.
84. Are the locking faces of the pallet stones at equal distance from the pallet center in the circular escapement?
84-A. No, but they are in an equidistant escapement.
85. What is meant by a watch rebanking? What may be the cause?
85-A. The balance takes an excessive motion, and the roller jewel hits the outside of the horns.
Caused by too strong a mainspring.
86. What would be the effect on the escapement if the let-off corner was broken off the L stone?
86-A. It would reduce or eliminate the Lock on the R. Stone due to insufficient lift.
87. In your opinion, what is the best way to test a watch for perfect beat?
87-A. By testing the let-off to see that it lets off of both pallets with equal ease with a small amount of power.
88. Name the various escapements that have been in common use for the past fifty years.
88-A. Lever, chronometer, cylinder, and duplex.
89. How many teeth does the average escape wheel have?
89-A. Fifteen.
90. When is an escapement overbanked or out of action?
90-A. When the roller jewel is out of fork slot.

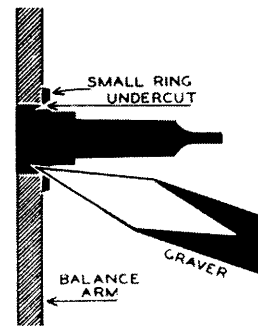
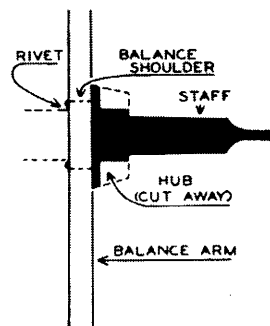
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| 91. What is meant by a Dead-Beat Escapement? | 91-A. An escapement without recoil. |
| 92. What is the recoil escapement? | 92-A. One where the escape wheel moves backwards in the unlocking. |
| 93. How many degrees lift in a lever escapement? | 93-A. Average 8-1/2 degrees. |
| 94. When does the lift occur? | 94-A. Immediately after the unlocking. |
| 95. What gives the lift? | 95-A. Escape tooth passing across the impulse face of the pallet stone. |
| 96. What is the object of the lift? | 96-A. To give impulse to the roller jewel. |
| 97. What is understood by impulse face of a pallet? | 97-A. The lifting angle on a pallet stone. |
| 98. How do you tell when impulse face is correct? | 98-A. When the locking is equal. |
| 99. How is this lift distributed in club and pointed tooth? | 99-A. In club tooth it is divided between teeth and stone. In pointed tooth, it is all on stone. |
| 100. How do you tell when pallets have right impulse face on pointed tooth? | 100-A. See if it has equal lock. |
| 101. How would you prove which pallet stone was incorrectly set on pointed tooth? | 101-A. Go by the angular motion to see whether you increase one or decrease the other. |
| 102. What would you do in case of unequal lift in pointed tooth? | 102-A. Change the angle of the impulse face of one or the other stone. |
| 103. How much drop in the lever escapement? | 103-A. Approximately 1-1/2 degrees. |
| 104. What is meant by the drop? | 104-A. Space between the left off corners of tooth and stone. |
| 105. When does the drop occur? | 105-A. After the impulse. |
| 106. What is the cause of too much or too little drop? | 106-A. Pallet Stones are too thick or too thin; or escape wheel teeth are too wide or too narrow. |
| 107. What is the object of the drop? | 107-A. To give clearance. |
| 108. Is there any bad effect in having too much drop? | 108-A. Yes. It can cause wear and loss of power. |
| 109. What is the cause of an unequal drop? | 109-A. Pallet Stones are too wide apart, or too close together. |
| 110. When is a lever watch banked to drop? | 110-A. When the banking pins are moved to such a position that the tooth of the escape wheel just drops off the stone at the instant the pallet fork is arrested by the bankings. |
| 111. What is the object of banking to drop? | 111-A. To test the watch for lock and alignment. |
| 112. Should a watch with a lever escapement be banked to drop to give good results? | 112-A. No. There would be no clearance. |
| 113. Can we have unequal drop when pallets are proper thickness and proper distance apart? | 113-A. No. |

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| 114. How many degrees lock in a lever escapement? | 114-A. 1-1/2 average. |
| 115. When does the lock occur? | 115-A. At the instant the escape tooth drops on the stone. |
| 116. What is meant by locking face of pallets? | 116-A. The face upon which the escape tooth drops. |
| 117. What is the lock for? | 117-A. To arrest the escape wheel while the balance performs its arc of vibration. |
| 118. What effect would it have on the locking if the pallets were set too far from the escape wheel? | 118-A. Reduce the lock. |
| 119. What is one cause of an unequal lock? | 119-A. Improper setting of pallet stones. |
| 120. What would you do in the case of unequal lock? | 120-A. Adjust one or both of the pallet stones. |
| 121. How many degrees opening to pallets? | 121-A. Sixty degrees. |
| 122. What is understood by opening of pallets? | 122-A. Angle from center of escape wheel to locking corners. |
| 123. What is understood by equidistant lockings? | 123-A. Locking faces on both stones are same distance from center of pallet. |
| 124. What is a circular pallet? | 124-A. Where the center of pallet stones is equal distance from the center of the pallets. |
| 125. What is meant by slide? | 125-A. Amount the tooth slides on the pallet. |
| 126. Is it necessary to have slide? | 126-A. Yes. |
| 127. How much slide? | 127-A. Approximately half as much as the lock. |
| 128. When does slide take place? | 128-A. Following the lock. |
| 129. What decreases or increases slide? | 129-A. Opening or closing the banking pins. |
| 130. Can you have slide without draw? | 130-A. No. |
| 131. Would the effect be good or bad in a light locking to open the bankings a little? | 131-A. Good. |
| 132. What is meant by draw? | 132-A. The angle of the locking faces of the pallets in a lever escapement. |
| 133. How many degrees draw to the pallets? | 133-A. 12 to 15. |
| 134. When does the draw take effect? | 134-A. As soon as it locks. |
| 135. Where is the draw laid off from? | 135-A. Locking Corner. |
| 136. Would the effect of a strong draw be good or bad, and why? | 136-A. Bad. Causes too much resistance to unlocking. |
| 137. What is the object of the draw and what do you understand by the term? | 137-A. Object is to hold lever against the banking to allow the balance freedom of motion. |
| 138. When is an escapement out of line? | 138-A. When the angular motion is not equal. |

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| 139. How do you test a lever watch to see if it is in line? | 139-A. Bank to drop and test angular motion. Test guard freedom. |
| 140. Name three ways of putting a watch in line. | 140-A. Moving pallet stones; moving fork on two piece pallet; bending fork. |
| 141. If the escapement was out of line and the jewel pin came to a line of centers when at rest, what effect, if any, would it have on the watch being in beat? | 141-A. It would be out of beat. |
| 142. Should the fork let off equal distance on either side of a line of centers? | 142-A. Yes, if it is in line. |
| 143. What is the ordinary length of fork as compared with diameter of escape wheel? | 143-A. $2/3$ to $3/5$. |
| 144. What is the general rule for the length of fork and roller to match? | 144-A. $3-1/2$ to 1; or 4 to 1. |
| 145. How do you tell when the roller is of proper size? | 145-A. If the safety action is correct, the roller would be the proper size. |
| 146. How much shake do you allow for jewel pin in fork? | 146-A. Approximately $2/100$ of a millimeter. |
| 147. How do you find out when jewel pin is too far back? | 147-A. Corner clearance test. |
| 148. When should roller jewel leave the fork? | 148-A. The instant before the fork is arrested by the bankings. |
| 149. What portion of a jewel pin should be taken off or flattened when drawing an escapement? | 149-A. $2/5$. |
| 150. What advantage, if any, in a double roller? | 150-A. Greater safety action. Decreases friction of guard pin on roller. |
| 151. What do you understand by double roller in lever escapement? | 151-A. Large or impulse roller carries roller jewel. Small or safety roller carries the passing hollow and performs the safety action. |
| 152. How many degrees angular motion to the lever? What gives the angular motion? | 152-A. 10 degrees. The $8-1/2$ degree lift and $1-1/2$ degree lock gives the angular motion. |
| 153. What is a Cylinder Escapement? | 153-A. A frictional dead-beat escapement. |
| 154. What is the advantage of a steel escape wheel over a brass? | 154-A. Lighter, strong and has better wearing qualities. |
| 155. What is a double roller escapement? | 155-A. The lever escapement in which a separate roller is employed for the guard action. |
| 156. What is a guard pin? | 156-A. A pin which prevents the watch from going out of action or overbanking. |
| 157. Explain all that you would do in putting in a pallet stone to replace one which is lost. | 157-A. If an American watch, select a stone of proper make and size and test for lock. If Swiss watch, select a stone to fit the slot and test for lock and lift. |

158. What is the Impulse Pin or Roller Jewel? 158-A. The impulse pin or roller jewel is the ruby or sapphire pin of the lever escapement which, entering the notch of the lever, unlocks the escape wheel and then receives the impulse from the lever and passes out of the opposite side.
159. What is the purpose of an escapement? 159-A. The escapement is that part of the watch which changes the circular force of the escape wheel into the vibratory motion of the balance.
160. What is the straight line escapement? 160-A. A straight line escapement is one in which the pallets, lever and balance are all in a straight line.
161. What is the right angle escapement? 161-A. In a right angle escapement, we find the line of centers of the pallet and balance crossed at right angles by the line of the escape wheel.
162. What is a semi-tangential escapement? 162-A. In a semi-tangential escapement location of the pallets is a compromise between the circular and equidistant escapement.
163. What is the purpose of the horns? 163-A. Horns on the lever have no definite purpose in single roller, except that they act as a safety in case of a jar to carry the jewel pin safely across from one side of the roller to the other. In the double roller they provide the safety action after the guard pin has entered the passing hollow.
164. What is meant by the term "long fork"? 164-A. If the roller jewel will not pass out of the fork slot when the escapement is banked to drop, it is called a long fork.
165. What is meant by the term "short fork"? 165-A. If the roller jewel shake is so great as to allow the pallet stone to unlock when an escapement is banked to drop, it is called a short fork.
166. In an ordinary watch, what do you call the fifth wheel? 166-A. Escape wheel.
167. In adjusting an escapement, name the procedure. 167-A. Check your bank to drop; lock; slide; drop; draw; guard freedom.
168. What is meant by a detached lever escapement? 168-A. It is an escapement in which the balance is free from the escapement and solely under the influence of the hairspring, except when unlocking and receiving the impulse.
169. What is a poised fork? 169-A. A poised fork is a fork which has an extension on the side opposite the horns to balance or counterpoise it.
170. How many vibrations per minute does the balance make in the three different trains in American bracelet watches? 170-A. Fast Train..... 300
Quick Train..... 330
Extra Quick Train.... 360

171. How would you remove a broken screw from the rim of a balance?
- 171-A. Drill through the screw with drill slightly smaller than the thread of the screw, then broach the remainder.
172. What would you say is the proper amount of space between the balance and cap jewels?
- 172-A. $2/100$ of a millimeter.
173. What do you consider the proper thickness of a balance jewel in comparison with the size of the hole?
- 173-A. Approximately one-half the size of the hole.
174. How long should a balance pivot be compared to its diameter?
- 174-A. 2 to $2-1/2$ times as long as the diameter.
175. In your opinion, what is the proper amount of end shake on a balance staff for a pocket watch?
- 175-A. $2/100$ of a millimeter.
176. What is meant by an olive balance hole jewel and what is its purpose?
- 176-A. The hole in an olive balance hole jewel is rounded on the inside instead of being straight. The purpose is to reduce friction.
177. What is the purpose of a compensating balance?
- 177-A. To compensate for loss or gain in heat or cold.
178. If the end of a balance pivot is flat and you make it slightly round, will it cause a slower or faster rate on that pivot?
- 178-A. Slower.
179. Name two kinds of hairsprings and explain the difference.
- 179-A. Breguet or overcoil and flat.
180. If, in putting in new balance staff, your nearest selection has pivots a trifle too large, explain fully how you reduce their diameter.
- 180-A. Grind with oilstone powder or crocus and polish with diamantine.
181. How do you remove a balance staff from a balance wheel of ordinary construction?
- 181-A. Chuck it up in the lathe and undercut the rivet, or turn away the hub.



182. Why are some balances made of two metals and cut?
- 182-A. To compensate for changes in temperature.
183. Why are two metals used in a compensating balance?
- 183-A. Because of their difference in expansion and contraction.
184. Why are steel and brass used?
- 184-A. Brass has a greater coefficient of expansion than steel.
185. What do you understand by a composition balance?
- 185-A. A balance made of alloyed metal.

186. How do you true a balance? 186-A. With a good truing caliper. First level the arms, then raise the lower segments until true in the flat. In the round, check to see that the arms are both the same length, then bring the rim in or out to conform with the edge of rim at end of arm, until both sections are true in the round.
187. How much of an arc should the balance make when the watch is in good condition? 187-A. 1-1/2 arcs or 540 degrees.
188. How do you select a balance staff? 188-A. You select a balance staff for the make of watch, size, length of staff, diameter of pivots, proper diameter of collet and roller shoulders.
189. Explain how you fasten a balance staff to a balance wheel of ordinary construction. 189-A. By first staking with a round face hollow and a flat face hollow staking punch.
190. Name the two other kinds of staffs and explain the difference. 190-A. Waltham Friction Taper Shoulder Staff, and Hamilton two-piece Friction Staff. The part which is the hub is staked into the balance arm permanently. The broken staff may be driven out and the new one driven in friction tight.
191. What is a compensating balance? 191-A. A compensating balance is a bimetallic balance consisting of approximately 2/5 steel and 3/5 brass.
192. What is the usual time value of a pair of balance screws? 192-A. A pair of regular sized screws added or removed from the balance of a pocket watch will vary the time approximately one hour per day. Some factories make screws known as heavy, medium, and light. Other companies make a line of timing screws for their watches, each pair having a specifically stated time value.
193. What is the purpose of the balance? 193-A. The vibratory wheel of a watch which in conjunction with the mainspring controls the progress of the hands.
194. Name the different kinds of screws that may be found on a balance. 194-A. Full head balance screws; timing screws; meantime screws.
195. Why are threads on some balance screws longer than others? 195-A. Those with long threads are fitted friction tight, and are called meantime screws. Moving a pair in will cause the watch to run faster.
196. What is Invar? 196-A. Nickel steel alloy containing approximately 36% nickel.
197. What is the most important property of Invar? 197-A. The expansion in the ordinary temperature range is negligible.
198. Explain how you take the staff measurements on a watch. 198-A. Overall length from outside of balance jewel settings. Then from outside of lower balance jewel setting to top of pallet bridge, and from outside of lower balance jewel

setting to top of fork. The balance of the measurements may be computed from these three measurements.

199. If the hairspring of an 18,000 beat train was vibrated one count per minute fast, how much would the watch gain in 24 hours?

199-A. 9 minutes and 36 seconds.

SOLUTION:

1 Beat per minute equals $2/5$ sec.
 $2/5$ sec. x 60 minutes equals 24 (the number of seconds fast in 1 hour)
 24 sec. x 24 hrs. equals 576 (the number of seconds fast in 24 hours)
 576 divided by 60 (the number of seconds in one minute) equals 9.6

SUBSTITUTING:

$$\frac{.4 \times 60 \times 24}{60} \text{ equals } 9.6$$

200. Name two springs used in a hunting case.

200-A. Lift and lock.

201. What are the principal parts of an open face pocket watch case?

201-A. Frame or center, bezel, back, pendant, crown, bow.

202. What is the difference between an Open Face Watch and a Hunting Case Watch?

202-A. An open face watch has no cover or back. A hunting case watch has a cover protecting the glass. This cover is referred to as the front back.

203. What is the probable trouble with an American Pendant Set Watch when you pull the stem out to the setting position and it neither winds nor sets?

203-A. The sleeve may be in too far.

204. If the stem pulls out easily on an American Pendant Set Watch so that it occasionally gets in the setting position itself, what is usually wrong?

204-A. Usually a worn or broken sleeve.

205. What is a stem of a watch?

205-A. The stem is also known as the winding arbor.

206. What is the clutch?

206-A. A sliding pinion which shifts from winding to setting, or vice versa.

207. What is meant by Maintaining Power?

207-A. A mechanism for driving a watch or clock while being wound.

208. How do you take the excess shake out of a stem?

208-A. The shake in stem is generally due to the hole in between the plates being worn. In order to overcome excess shake in stem caused by wear, fit new stem with over-sized hub.

209. What is the purpose of the balance spring?

209-A. To regulate the time of vibrations of the balance.

210. Why is the Breguet Spring superior to a flat one?

210-A. The action is more concentric and more susceptible to adjustment for Isochronism.

211. Is a cylindrical spring superior to all others?

211-A. Yes.

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| 212. What do you understand by the word curb pins? | 212-A. Regulator pins. |
| 213. Should the hairspring vibrate between the curb pins? | 213-A. On a flat spring, yes.
On a overcoil spring, no. |
| 214. What is the proper distance between the curb pins? | 214-A. Approximately twice the thickness of the spring. |
| 215. In vibrating a flat hairspring, where should the point of vibration be placed? | 215-A. About half way between stud and regulator pins. |
| 216. About how many coils should a Breguet spring have? | 216-A. Fourteen or fifteen. |
| 217. Which way do you insert pin in collet and is it best to have pin flattened slightly? | 217-A. Insert same direction as spring enters collet. No, it is not best to flatten pin. |
| 218. About how many coils should a flat spring have? | 218-A. Fourteen or fifteen. |
| 219. If you were fitting a hairspring to a watch and you found it necessary, where would you add or take off weight? | 219-A. You make your change on the balance within 1/3 from the solid end. |
| 220. What is the hairspring? | 220-A. It is frequently termed balance spring, and is a small coiled spring which vibrates the balance. |
| 221. What is Elinvar? | 221-A. Elinvar is the same as Invar with 12% chromium added, replacing a like amount of iron. |
| 222. What is the most important property of Elinvar? | 222-A. The elastic strength does not change in the ordinary temperature range. |
| 223. What is known as a free spring? | 223-A. A balance spring with no provision for regulating by curb pins. Marine Chronometers, and occasionally very fine watches, have no curb pin regulator in them. Regulation is effected by meantime screws in the balance rim. |
| 224. What is the effect in increasing the weight of a pendulum bob? | 224-A. No effect, except if increased too much, it will stop. As long as impulse will throw it, no effect. |
| 225. How many millimeters are there in an inch? | 225-A. 25.4. |
| 226. How many millimeters are there in a Ligne? | 226-A. 2.26. |
| 227. Name materials used for making watch jewels. | 227-A. Garnet, ruby, sapphire, and sometimes a diamond. |
| 228. What is the difference between regulating a watch and adjusting a watch? | 228-A. Regulating a watch is timing it so it doesn't gain or lose.
Adjusting a watch is manipulating it so that it will keep equal time in different positions and temperatures. |
| 229. How do you remove the hands from a watch with a metal dial so as not to mar the dial? | 229-A. With a hand remover and a dial protector. |

230. If a watch should suddenly gain considerable time, name all the causes you can think of that might be the trouble.
- 230-A. Balance screw lost; balance out of true; oil on the hairspring; hairspring tangled.
231. What are each of the following:
- a. Chronograph Watch?
 - b. Repeater Watch?
 - c. Calendar Watch?
- 231-A.
- a. A Chronograph Watch is a recording time piece.
 - b. A Repeater Watch is one that strikes the time.
 - c. A Calendar Watch is one that records the date.
232. What is a:
- a. Bezel?
 - b. Pendant?
 - c. Bridge?
 - d. Crown?
 - e. Click?
- 232-A.
- a. A bezel is a grooved rim into which the watch glass or crystal is fitted.
 - b. A pendant is that part to which a bow is attached.
 - c. A bridge is the standard secured to the plate by means of screws and in which a pivot works.
 - d. A crown is the part you grasp when winding a watch.
 - e. A click is a dog or pawl which falls into a ratchet wheel and prevents it from turning backwards.
233. How often should the ordinary pocket watch be cleaned?
- 233-A. Every 12 to 18 months.
234. If you were fitting a second hand and found the hole in the socket too large, how would you close the hole to fit pivot?
- 234-A. Close hole in socket by placing in chuck and tightening draw in spindle.
235. In an 18,000 beat train, what fraction of a second does the second hand advance with each beat of the balance wheel?
- 235-A. $1/5$ of a second.
236. To what temper do you draw stem wind wheels?
- 236-A. Dark Blue.
237. How do you put the alarm hand on an alarm clock so as to have the clock ring at the time indicated?
- 237-A. Turn hands until cam drops, then put alarm hand on at the time hour and minute hands indicate.
238. Name at least two causes for a watch winding hard after being put together.
- 238-A. Lack of oil under crown wheel, or not aligned with stem in case.
239. How do you regulate a pendulum bob?
- 239-A. By raising or lowering.
240. What clock will keep the best time, one driven by mainspring power or one driven by weight?
- 240-A. The one driven by weight keeps the best time because the power is more constant.
241. How may you prevent steel from being oxidized when hardening?
- 241-A. Cover with powdered boracic acid or soap.
242. Explain the advantage of a recoil click.
- 242-A. The recoil click prevents winding the main-spring too tightly.
243. When a watch varies in the pendant positions, what may be some of the troubles?
- 243-A. Balance out of poise; hairspring out of true or out of center; curb pins open.
244. If you had to enlarge the hole in a porcelain dial, how would you do so without chipping?
- 244-A. Use a tapered broach charged with diamond powder.

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| <p>245. What are the chief causes of variations in different temperatures?</p> <p>246. What are the most important qualities required for good watch oil?</p> <p>247. What time of day would it be when a ship or marine clock strikes eight bells?
Five bells?

One bell?</p> | <p>245-A. Expansion and contraction of balance wheel; lengthening and shortening of the hairspring.</p> <p>246-A. Must remain liquid when exposed to intense cold.
Must evaporate slowly under intense heat.
Must not corrode on metal.
It must not become gummy.
It must not creep.</p> <p>248-A. When it strikes eight bells, it is 12, 4 or 8 o'clock.
When it strikes five bells, it is 2:30, 6:30 or 10:30.
When it strikes one bell, it is 12:30, 4:30 or 8:30.</p> |
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EXAMPLES:

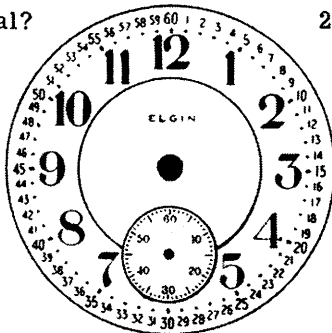
1 Bell.....	12:30	4:30	8:30
2 Bells	1:00	5:00	9:00
3 Bells	1:30	5:30	9:30
4 Bells	2:00	6:00	10:00
5 Bells	2:30	6:30	10:30
6 Bells	3:00	7:00	11:00
7 Bells	3:30	7:30	11:30
8 Bells	4:00	8:00	12:00

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| <p>248. What parts of a watch do you oil?</p> <p>249. What is meant by adjustment of a watch?</p> <p>250. What is meant by position adjustment?</p> <p>251. What is meant by adjusting to Isochronism?</p> <p>252. What is meant by adjusting a watch to temperature?</p> <p>253. How do you test a watch for magnetism?</p> <p>254. What is the effect of magnetism on a watch?</p> <p>255. Define the following parts; dial; bob of a clock; cannon pinion.</p> | <p>248-A. The winding wheels, the mainspring, all pivots, the center post, the escape wheel teeth; in other words, where there is friction. Do not oil roller or hour and minute wheels.</p> <p>249-A. Manipulating the balance, its spring and staff for the purpose of improving the time keeping qualities of the watch. Adjusting to position, isochronism and temperature.</p> <p>250-A. The manipulation of the hairspring, curb pins, and balance so that the movement keeps time in the different positions.</p> <p>251-A. The manipulation of the hairspring so that the long and short arcs of the balance are performed in the same time.</p> <p>252-A. Manipulation of the balance screws to cause a watch to rate the same in heat and cold.</p> <p>253-A. By the use of a small compass, preferably with the magnetism removed.</p> <p>254-A. It causes the watch to run erratically.</p> <p>255-A. A Dial is a graduated face of a time piece. Bob of a clock is the metal weight at the bottom of a pendulum.
Cannon Pinion is the pinion to which a minute hand is attached.</p> |
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256. What is a Marine Chronometer? 256-A. A chronometer hung in gimbals for use at sea.
257. What is a potance? 257-A. A lower bridge, or hang down bracket fastened on the under side of the upper plate of an 18 size watch.
258. What is a Demagnetizer? 258-A. A device used to remove magnetism from parts of watches.
259. Name the jewels in a 21 jewel watch. 259-A. 2 Balance hole jewels
6 Cap jewels
2 Pallet jewels
1 Roller jewel
2 Pallet arbor hole jewels
2 Escape pinion hole jewels
2 Third pinion hole jewels
2 Center pinion hole jewels
2 Fourth pinion hole jewels
260. When cleaning a watch, do you remove the mainspring from the barrel? 260-A. Yes.
261. What is a regulator of a watch? 261-A. The part to which the curb pins are attached.
262. How do you remove a broken screw from a plate? 262-A. Dissolve screw out in solution of alum water, or one part of sulphuric acid to 9 parts of water. If plate should discolor in either of these solutions, immerse in cyanide solution to restore finish.
263. What is Solar Time? 263-A. Sun time.
264. After placing a staff in a watch, and you find that the watch runs 2 or 3 minutes fast, explain how you would bring that watch to time. 264-A. If watch was running fast, turn the meantime screws out. If watch is running slow, turn the meantime screws in. If watch was running slow, in absence of meantime screws, reduce weight of balance by undercutting screws. If watch was running fast in absence of meantime screws, add weight in form of timing washers.
265. What are meantime screws? 265-A. Screws usually placed at quarters. Often called quarter screws. Threaded friction tight so they can be moved in or out. The purpose of meantime screws is to bring the watch to time without the use of the regulator.
266. How do you make a Swiss stem? 266-A. Select a piece of steel as large as the hole through the plate. Turn pivot, locate slot, fit winding pinion and clutch. Cut off proper length and thread for crown. Harden and temper to a blue.
267. If you flatten the ends of the balance pivots, what effect would it have in regard to rate? 267-A. By flattening the ends of the balance pivots, you would increase the friction, which would reduce the arc of the balance, and thereby increase the rate in the dial up and dial down positions.

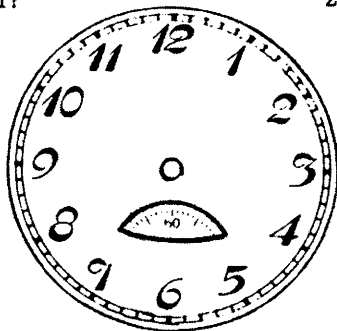
268. Name the most important steps when taking a watch apart for cleaning and oiling and reassembling.
- 268-A. 1. Remove hands, dial and dial train.
2. Remove balance and bridge, being very careful with the hairspring.
3. Press back click and release the power slowly with the stem or bench key.
4. Remove pallet bridge and fork.
5. Remove winding wheels.
6. Remove bridges, barrel and train.
7. After cleaning all parts thoroughly, put mainspring and arbor in the barrel and oil.
8. Assemble balance hole jewels and cap jewels and oil.
9. Assemble barrel, train and pallet in watch oil, commencing at center.
10. Place balance in watch.
11. Check to see that hairspring is true in the round and flat and centered.
12. Oil center staff and replace cannon pinion.
13. Complete oiling at all points of friction including three of four teeth of escape wheel.
14. Complete assembly by replacing dial and hands.
269. What is a full plate watch?
- 269-A. In a full plate watch the balance and balance bridge are above the plate.
270. What is a 3/4 plate watch?
- 270-A. A 3/4 plate watch is where the balance is in the movement or below the surface of the plate.
271. Name the different kinds of crystals used in open faced watches.
- 271-A. Mi-concave; lentile; lentile chevee.
272. What is the name of the crystal used in hunting case watches?
- 272-A. Geneva.
273. How often should bracelet watches be cleaned?
- 273-A. Bracelet watches should be cleaned every 9 to 12 months. Very small watches should be cleaned every 6 to 9 months.
274. How would you transfer oil from your bottle to the oil cup and why?
- 274-A. Use a clean glass rod so that you do not contaminate your oil supply, or keep your oil in a hypodermic needle.
275. What is a floating or self centering stud?
- 275-A. It is the type of stud which when free allows the spring to seek its centered position, and which is held firmly in place with a small plate, which is held in position by two screws.
276. Name or illustrate eight kinds of jewels.
- 276-A. Regular cap; balance; plate; friction cap; friction balance; friction plate; roller jewel; pallet jewels; barrel arbor jewels.
277. What is a patent regulator?
- 277-A. It is a type of regulator which makes possible a micro-meter adjustment.
278. What is a double sunk dial?
- 278-A. A dial which is in three parts before being assembled, each portion at a different level.

279. What is a Montgomery dial?



279-A. It is a dial showing numbers 1 to 60 on the margin, indicating minutes.

280. What is a Secometer Dial?



280-A. A secometer dial has an aperture through which the rotating second dial may be seen.

281. Where would you look for the trouble if a watch stops every five minutes?

281-A. The trouble may be caused by the cannon pinion if 12 leaf, or by the center pinion if 12 leaf.

282. What is Epilame process?

282-A. Pivots or plates are dipped in a liquid solution which prevents oil from creeping away.

283. Where are conical pivots found other than on the balance staff?

284-A. Conical pivots are found wherever the hole jewel is capped.

284. Where is the stop works found in a watch?

284-A. The stop work mechanism is usually found on the under side of the mainspring barrel.

285. What two different systems of measurements are used for Mainsprings?

285-A. Metric and Dennison.

286. Does Re-Banking mean the same as Over-Banking?

286-A. Re-Banking is caused by excessive motion. Over-Banking, providing the watch is correct in every other way, is caused by faulty guard pin, which action means the guard pin is too far away from the roller or too short.

287. What do you consider good timing qualities for a high grade watch? What should be the limit of error per week?

287-A. Within thirty seconds per week.

288. What is a depthing?

288-A. Distance between centers. It is the amount which a wheel will engage into a pinion.

289. In what way may a depthing be defective, and how is this to be remedied?

289-A. A depthing could be remedied by uprighting. Faulty depthing is usually corrected with a rounding up tool.

290. What is the length of the pendulum on a second beat clock?

290-A. 39 and a fraction inches.

291. What allowance is made between diameter of the reamer and the diameter of a friction jewel to obtain a friction fit?

291-A. 1/100 millimeter.

292. Name the different temper colors.

292-A. Light straw, yellow straw, light brown, dark brown, purple, dark blue, light blue, gray.

293. Name the three different lengths of running time on watches with one winding.

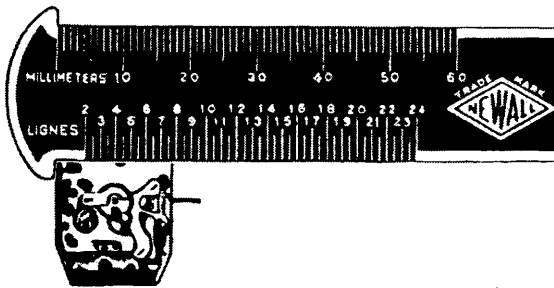
293-A. The ordinary watch should run 36 to 40 hours, 60 hours, or eight days.

294. How do you clean dials?

294-A. Cyanide Potassium solution is an excellent tarnish remover. Rinse in cool water.

295. How do you measure a watch for size?

295-A. Use watch gauge, or a millimeter gauge, and measure diameter of pillar plate on the dial side.



296. What is a simple train?

296-A. Where the teeth of one wheel engage the teeth on another wheel.

297. What is a compound train?

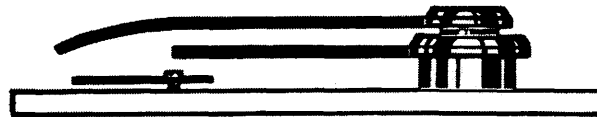
297-A. Where wheels depth into pinions.

298. What is meant by friction jewel?

298-A. Jewels are placed into the proper position in a watch friction tight. The proper friction is obtained by pressing the jewel into a hole in the plate or bridge, and the hole is approximately 1/100 of a millimeter smaller in diameter than the jewel.

299. How do you adjust the hands on a watch?

299-A. The hands should be parallel with the dial.



300. What is required to attain a good regulation?

300-A. The barrel must be free from faults. The mainspring must be of the right dimensions, the train free, the escapement properly adjusted, proper fit of balance pivots and proper end shake, balance true and poised, hairspring true, flat and centered, and the curb pins in the proper position.

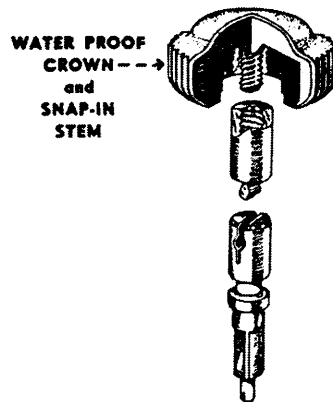
301. What is the purpose of a Rounding Up Tool?

301-A. A rounding up tool is used for touching up the teeth of a wheel or reducing the diameter very slightly.

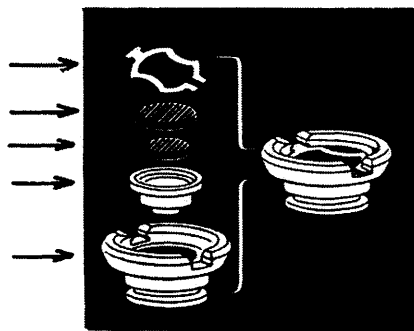
302. What is a Depthing Tool?

302-A. An adjustable tool used to determine the distance between centers.

303. How do you close the socket in an hour hand? 303-A. The socket of an hour hand is closed with a taper mouth punch used in the staking tool.
304. How do you close the hole in a minute hand? 304-A. The hole in a minute hand may be closed by using a round edge punch which is slightly larger than the hole, which when tapped lightly with a hammer, will reduce the diameter of the opening.
305. How do you close the pipe or tube on a second hand? 305-A. By placing it in a chuck in a watchmaker's lathe and tightening the Draw-In Spindle, which closes it the entire length.
306. How may the moving parts in a watch movement be classified? 306-A. Winding parts; motive parts; transmitting parts; distributing parts; regulating parts; setting parts; time showing parts.
307. What is the use of jewels in a watch movement? 307-A. To reduce wear and friction of the moving parts to a minimum. Oil sinks in the jewels provide for adequate storage of oil.
308. What is the difference between Sport Timers and Chronographs? 308-A. Sport Timers do not tell time.
309. On what type watches are snap-in crowns and slotted stems used? 309-A. On waterproof watches.



310. What do you understand by Incabloc assembly? 310-A. The assembly consists of the balance jewel cap jewel and spring, the purpose being to absorb shock when the watch receives a blow or is dropped.



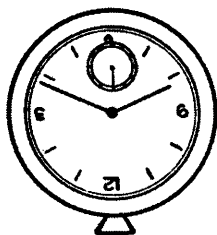
311. When replacing a strap on a strap watch case, is the buckle end placed at 12 or 6? 311-A. 12.

312. Explain your method of cleaning and oiling a watch correctly.
- 312-A. The two methods of cleaning a watch are known as hand method and cleaning by machine method. Both methods require the use of a cleaning fluid which will remove the dirt and old oil and brighten the watch parts, after which all parts are thoroughly rinsed before drying. Regardless of the method used, all pivot holes should be thoroughly pegged before the watch is assembled.
313. If a watch was handed to you for repair, how would you go about examining it?
- 313-A. First examine to see if the case is tight, after which test the winding and setting. Then remove the movement from case, remove hands and dial and balance from the watch. Examine carefully and proceed to estimate the necessary repairs.
314. What is the difference between Static Poise and Dynamic Poise?
- 314-A. A balance is static poised on a poising tool. When the balance is in perfect static poise, it must come to rest and remain at rest in any position it may be placed. Dynamic poise refers to conditions which arise when the balance of the watch is in motion, which in turn effects the rate of a watch.
315. When is a watch adjusted to temperature?
- 315-A. When proper adjustments have been made on balance for heat and cold.
316. If a watch gains in heat, what is the action and which way would you move the screws?
- 316-A. Balance expands in heat, and for that reason screws must be brought nearer arm, away from cut end.
317. Why are gold and platinum screws sometimes used?
- 317-A. For appearance and weight.
318. What is the first thing to be done in adjusting to heat and cold?
- 318-A. Get difference in rate between heat and cold.
319. What are the extreme temperatures used when adjusting to heat and cold?
- 319-A. 45 to 90 degrees.
320. Should a watch always remain in one position while being adjusted to temperature and why?
- 320-A. Yes, so as to eliminate position error.
321. How is temperature adjustment obtained?
- 321-A. When a watch is adjusted to temperature, it is run 24 hours dial up in a temperature of 90 degrees F, and its rate compared with a standard. It is then run 24 hours dial up in a temperature of 40 degrees F. If it then shows a gain in the 40 degrees temperature as compared with the running in the 90 degree, it is said to be under compensated. This is remedied by moving screws nearer the free ends of the rim.
322. What effect in timing to position would it have if the balance was out of poise?
- 322-A. Make vertical positions variable.
323. What is plus action and what is minus action?
- 323-A. Plus means gain; minus means a loss; although some writers reverse the signs.

324. Is the balance ever put out of poise in timing to position? 324-A. Sometimes done. Not recommended.
325. What effect does a thick hole jewel have on the rate of timing? 325-A. You would make vertical position slow.
326. Should the pivot be made flat on the end to equalize the friction? 326-A. No.
327. When is a watch in Isochronal condition? 327-A. A watch is Isochronal when the short arcs of the balance have the same time value as the long arcs.
328. Is the pinning of a hairspring to a collet usually above or below the line of centers and why? 328-A. Usually above. It is pinned below when seeking a slower rate in pendant up position.
329. Name the 6 different positions to which a watch is commonly adjusted. 329-A. Dial up; Dial down; Pendant up; Pendant down; Pendant right; Pendant left.



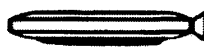
Vertical
Pendant Up



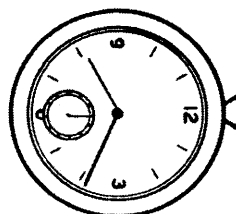
Vertical
Pendant Down



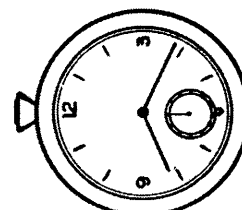
Horizontal
Dial Up



Horizontal
Dial Down



Vertical
Pendant Right

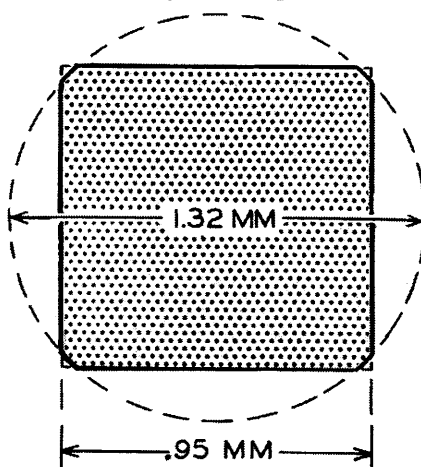


Vertical
Pendant Left

330. What do the letters P F & A stand for? 330-A. Pallet Fork and Arbor.
331. How do you determine the diameter of the round section from which you will mill or file the square for the winding clutch? 331-A. Multiply one side of the square by the constant 1.39.

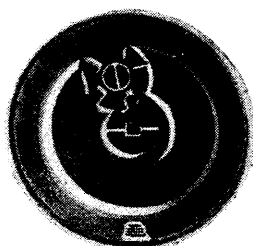
Example:

.95 MM Multiplied by 1.39 equals 1.32 MM



332. What is the purpose of the Stop Works?

332-A. The Stop Works prevent the mainspring from being wound up completely and also prevents it from running down entirely. It utilizes that portion of the mainspring which is most uniform in its delivery of power.



333. Many books containing tables of American Watch sizes list the measurement of an 18 size pillar plate at 44.87 mm. This is not correct. What is the correct diameter?

333-A. 45.7 mm.

Solution:

Measure one.

The following chart is a standard of points for grading repairs made. It is included here to give the student the point values placed on practical repairs to make a perfect grade.

1. Function of winding.....	4	Points
2. Function of setting	2	"
3. Clearance and fit of hands.....	5	"
4. Condition of jewel settings and screws	5	"
5. Motion - dial up	4	"
6. Motion - dial down.....	4	"
7. Motion - Pendant down	4	"
8. Freedom of train	3	"
9. Condition of lock, drop and slide	10	"
10. Jewel Pin Shake.....	4	"
11. Guard Pin Shake.....	4	"
12. Endshake of balance staff.....	4	"
13. Sideshake of balance staff	4	"
14. Trueness of balance wheel	7	"
15. Condition of balance pivots.....	5	"
16. Centering and condition of hairsprings	5	"
17. Flatness and trueness of collet	5	"
18. Condition of overcoil.....	5	"
19. Condition of regulator pins.....	2	"
20. Condition of cleaning.....	4	"
21. Condition of oil.....	4	"
22. Condition of all steel parts.....	4	"
23. General appearance	2	"

Total 100 Points

Sizes of American Watches

One Inch = 25.4 MM.

SIZE	MM	SIZE	MM
18	45.7	6/0	25.4
16	43.1	8/0	23.7
14	41.5	10/0	22.0
12	39.8	12/0	20.31
10	38.1	14/0	18.6
8	36.4	15/0	17.8
6	34.7	16/0	16.9
4	33.0	18/0	15.2
0	29.6	20/0	13.5
3/0	27.9	21/0	12.7
4/0	27.09	22/0	11.8
5/0	26.2	26/0	8.5

Sizes of Swiss Watches

One Ligne = 2.258 MM.

LIGNES	MM	LIGNES	MM
3	6.77	11 $\frac{3}{4}$	26.51
3 $\frac{1}{4}$	7.38	12	27.07
3 $\frac{1}{2}$	7.87	12 $\frac{1}{4}$	27.63
3 $\frac{3}{4}$	8.42	12 $\frac{1}{2}$	28.20
4	9.03	12 $\frac{3}{4}$	28.79
4 $\frac{1}{4}$	9.59	13	29.33
4 $\frac{1}{2}$	10.15	13 $\frac{1}{4}$	29.89
4 $\frac{3}{4}$	10.72	13 $\frac{1}{2}$	30.45
5	11.28	13 $\frac{3}{4}$	31.02
5 $\frac{1}{4}$	11.84	14	31.58
5 $\frac{1}{2}$	12.40	14 $\frac{1}{4}$	32.15
5 $\frac{3}{4}$	12.97	14 $\frac{1}{2}$	32.71
6	13.53	14 $\frac{3}{4}$	33.27
6 $\frac{1}{4}$	14.10	15	33.84
6 $\frac{1}{2}$	14.66	15 $\frac{1}{4}$	34.40
6 $\frac{3}{4}$	15.23	15 $\frac{1}{2}$	34.98
7	15.79	15 $\frac{3}{4}$	35.53
7 $\frac{1}{4}$	16.35	16	36.09
7 $\frac{1}{2}$	16.92	16 $\frac{1}{4}$	36.66
7 $\frac{3}{4}$	17.48	16 $\frac{1}{2}$	37.22
8	18.05	16 $\frac{3}{4}$	37.78
8 $\frac{1}{4}$	18.61	17	38.35
8 $\frac{1}{2}$	19.17	17 $\frac{1}{4}$	38.91
8 $\frac{3}{4}$	19.74	17 $\frac{1}{2}$	39.48
9	20.30	17 $\frac{3}{4}$	40.04
9 $\frac{1}{4}$	20.87	18	40.60
9 $\frac{1}{2}$	21.43	18 $\frac{1}{4}$	41.17
9 $\frac{3}{4}$	21.99	18 $\frac{1}{2}$	41.73
10	22.56	18 $\frac{3}{4}$	42.30
10 $\frac{1}{4}$	23.14	19	42.86
10 $\frac{1}{2}$	23.69	19 $\frac{1}{4}$	43.42
10 $\frac{3}{4}$	24.45	19 $\frac{1}{2}$	43.99
11	24.81	19 $\frac{3}{4}$	44.55
11 $\frac{1}{4}$	25.38	20	45.12
11 $\frac{1}{2}$	25.94		