



Founded 1858

British Horological Institute

Certificate in Clock and Watch Servicing

Unit 1: Technician Grade

Theory of Clock and Watch Servicing

15th November 2006

Time allowed: - 2½ HOURS

Important notes - please read carefully

1. You will be known to your Examiners by your examination number only, please put this number at the top right hand corner of all sheets of paper you use, including Section E.
2. There are four sections, A, B, C, D where each question carries twenty marks. Section E, which is on two separate pages, contains twenty short answer questions, each of which carries one mark.

3. You should attempt questions as follows: -

A total of four questions, one from each of Sections A, B, C and D.

All questions from Section E should be attempted and, as only brief answers are expected, the answers should be written in the spaces provided on the question paper.

At the end of the examination period the pages giving your written answers to Sections A, B, C and D together with Section E, should be numbered in sequence before being collected by the invigilator. All answers should be clearly numbered.

4. Good informative sketches or drawings, with the various components labelled, should accompany all descriptive answers, where appropriate, since they could attract a significant proportion of the total marks awarded.
5. All answers must be written in blue or black ink, using a pen or ball point. Pencil will not be accepted except where appropriate in sketches or drawings.
6. Any calculations required must be shown and laid out in a clear and logical manner. The use of non-programmable calculators is allowed.
7. You may use the following data, if required:
 $\pi = 3.142$, $g = 9.812 \text{ ms}^{-2}$, length of seconds pendulum = 994.16mm.
8. Please make sure that the question paper accompanying these instructions is appropriate to your examination entry.

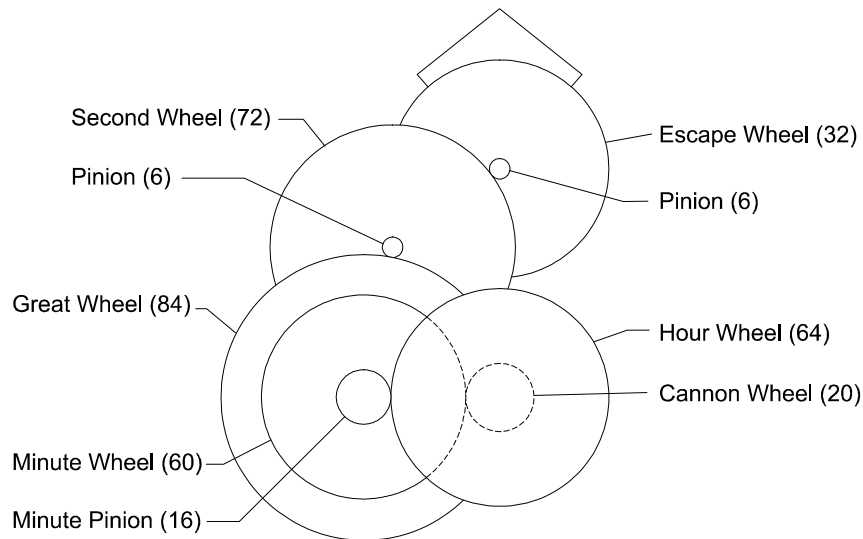
Certificate in Clock and Watch Servicing, Unit 1 Technician Grade, Theory of Clock and Watch Servicing

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Section A

Clocks and Clock Servicing – answer one question from this section.

- 1) a) Often, a 30-Hour Longcase Clock does not have an exact seconds pendulum. A typical



30-hour train is shown above, with tooth numbers in brackets. Calculate the number of beats per hour for this train, the time of one vibration and the theoretical pendulum length. (12 marks)

- b) Explain the meaning of the following terms, as applied to clock pendulums: simple pendulum, compound pendulum, centre of suspension, centre of oscillation, isochronism, circular error, lenticular bob, rating nut. (8 marks)
- 2) a) Use notes and sketches to describe the three types of pivot known as straight, conical and cone pivots. (6 marks)
- b) For straight pivots, explain, with the aid of a sketch, the type of wear that occurs if the pivot is too long, and also if it is too short. (4 marks)
- c) Some striking clocks give a single blow at the half hour, as well as striking the hours. For both rack and countwheel striking, describe the modifications that are made to the basic design in order to achieve this. (10 marks)

Section B

Watches and Watch Servicing – answer one question from this section.

- 3) a) Draw a labelled diagram of the modern form of keyless work typically found in mechanical wristwatches. (9 marks)
- b) Explain the action of the mechanism in the winding position. (6 marks)
- c) Explain the action of the mechanism in the hand setting position. (5 marks)
- 4) a) Briefly explain the function of each of the following components in a quartz watch:- quartz crystal, integrated circuit, coil, rotor, trimmer, transmission wheels, stop lever, sliding pinion. (10 marks)
- b) Give the six standard tests, other than battery testing, that should be carried out before and after servicing a quartz watch. (6 marks)
- c) Failure in a quartz watch can be due to one of the following: mechanical fault, faulty grounding switch, damaged coil, other electrical fault. Assuming the battery is good but the watch is not working, state which fault you would suspect in each of the following cases.
- No pulses from integrated circuit.
- Pulses present, low consumption with stem in.
- Pulses present, high consumption with stem in.
- Pulses present, high consumption with stem out. (4 marks)

Section C

Escapements – answer one question from this section.

- 5) a) Draw a diagram showing clearly the forked end of the lever and double roller assembly in a jewelled lever escapement. Label the following items: impulse roller, safety roller, impulse pin, passing crescent, horns, guard pin, banking pins, and the left and right flanks of the notch. (10 marks)
- b) Describe the safety action of the escapement and explain why it is necessary. (4 marks)
- c) Use notes and sketches to show how regulation is most commonly achieved in a watch fitted with this type of escapement. (6 marks)
- 6) a) Describe, with the aid of a sketch, the action of the recoil anchor escapement, explaining the terms impulse, inside drop, outside drop and recoil. (10 marks)
- b) Explain the terms; escaping angle, supplementary angle, impulse angle of the pallets, angle of recoil and angle of drop; as applied to the anchor recoil escapement. (10 marks)

Section D

Workshop Processes – answer one question from this section.

- 7 a) Taps and dies are used for cutting internal and external threads when required. Describe these components and explain how the die should be used to cut an external thread. (8 marks)
- b) Four files frequently used in Horology are the barrette file, crossing file, pivot file and screw head file. Describe each of these and explain its use. (8 marks)
- c) Describe the techniques known as, "diagonal filing" and "draw filing" and explain how these assist in filing flat. (4 marks)
- 8 a) Describe the construction of the double roller rest and explain how you would use it to file a winding square on the end of a barrel arbor. (8 marks)

Give a description of each of the following tools and explain their typical uses in Horological work.

- b) The graver. (4 marks)
- c) The cutting broach. (4 marks)
- d) The round broach. (4 marks)



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Section E

WRITE YOUR EXAMINATION NUMBER HERE

Write a brief answer in the space provided below each question. (1 mark is awarded for each question)

1. Why is a recoiling click fitted to modern mechanical watches?
2. What is the function of a fusee ?
3. What is another name for a split chuck ?
4. Why were cycloidal cheeks present in clocks?
5. Who invented the detached lever escapement ?
6. What is the advantage of turning work between centres ?
7. What is the shape of a crossing file ?
8. Why are detachable barrel arbors found in some clocks?

9	What is the correct method for cleaning away any metal clogging the teeth of a file?
10	What parts of a watch normally provides the friction coupling to drive the motion work?
11	What influence does a reduction in temperature have on the period of oscillation of a plain metal pendulum?
12	Where, in a clock, would you expect to find a fixed click , as opposed to a pivoted click?
13	What are the two main elements of brass ?
14	How does the strength of a mainspring vary with thickness?
15	Where should a winding click be pivoted, in relation to the ratchet, to ensure a safe action?
16	In a fusee movement, what is meant by set up ?
17	How is the friction drive for hand setting provided in a true Roskopf movement?
18	A striking train should lock immediately after the last blow has been struck. Why is this?
19	What is meant by the piezo electric effect ?
20	How should you clean the rotor of a quartz watch?