

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

GEOMETRICAL AND MECHANICAL DRAWING

9351/02

Paper 2

May/June 2006

3 hours 10 minutes

Additional Materials: A2 drawing paper
Standard drawing equipment

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name at the bottom right-hand corner of every sheet of paper you use.

You should spend the first ten minutes in reading the whole question paper before attempting the questions.

Short concise notes and small, auxiliary sketches may be presented to clarify any design features.

If you use more than one sheet of paper, fasten the sheets together.

Do not use staples, paper clips, highlighters, glue or correction fluid.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

Dimensions are given in millimetres.

This document consists of **3** printed pages, **1** blank page and **1** insert.



AUTOMOBILE DIAPHRAGM PUMP

The inserted drawings, in third angle projection, show the components of an automobile diaphragm pump for supplying petrol, under light pressure, to an engine.

Method of assembly

The ACTUATING LEVER pivots on an 8 mm diameter pin, between the lugs of the mounting flange of the PUMP BODY and is operated by a rotating cam in contact with face **L**.

The PUMP ROD connects the flexible synthetic rubber DIAPHRAGM to the ACTUATING LEVER.

The DIAPHRAGM is positioned between the PUMP BODY and OUTLET CHAMBER.

Two springs provide the return forces as the cam rotates. The smaller 10 mm diameter LEVER SPRING is located in the blind 11 mm diameter hole of the PUMP BODY and fits into the 10 mm diameter hole in the ACTUATING LEVER.

The larger 24 mm diameter DIAPHRAGM SPRING is located within the DISHED WASHER under the DIAPHRAGM.

The INLET FLANGE is held in position on the OUTLET CHAMBER, by five high tensile, standard hexagonal headed bolts which pass through the OUTLET CHAMBER and DIAPHRAGM and are screwed into the BODY. Suitable spring washers need to be shown under the heads of the five M6 bolts.

To complete the required view in Question 1, a number of design features need to be considered. Modifications and additions will need to be made to the given components and it is essential that the designed items are drawn clearly on the required views. These design features should be supported by annotated sketches, suitably positioned on your answer sheet.

The Design Features are:

- (i) a means of sealing the joint between the INLET FLANGE and the OUTLET CHAMBER with a nominal thickness of 1.5 mm; [2]
- (ii) suitable non-return valves in the ports of the INLET FLANGE and OUTLET CHAMBER. The two valves operate as petrol is sucked into the chamber through the inlet flange before it is then pumped out through the outlet port; [10]
- (iii) a plain bearing is required to guide the PUMP ROD as it reciprocates in the PUMP BODY. Note a detailed drawing of your bearing is required for Question 4; [3]
- (iv) a method for ensuring that the M6 PUMP ROD remains secured to the DIAPHRAGM and does not work loose in use. Position a suitable washer under the fastener. Note that the DIAPHRAGM is made from soft synthetic rubber; [4]
- (v) an eccentric cam that imparts 5 mm of movement to the machined follower face **L** of the ACTUATING LEVER. [3]

With all the components assembled and the forked arm of the ACTUATING LEVER drawn lying in a horizontal position, as in the given detail drawing.

Answer **all** the following questions.

- 1 Draw, FULL SIZE, using either first or third angle projection, the following views:
 - (a) a sectioned elevation, the plane of the section and direction of the required view being indicated by **YY** on the detailed drawing of the PUMP BODY. The ACTUATING LEVER to be positioned as shown with the axis of the outlet port of the OUTLET CHAMBER, parallel to face **W** as shown on the detailed plan of the PUMP BODY; [27]
 - (b) a sectional plan view in projection with (a), the section plane being indicated by **XX** on the detailed drawing of the OUTLET CHAMBER when looking down into the PUMP BODY; [15]
 - (c) an end view in projection with (a) as seen when looking in the direction of arrow **Z**, indicated on the detailed drawing of the PUMP BODY. [14]

NOTE

The eccentric cam profile is to be included only in view (a).

Hidden detail is not required in any view unless it is necessary to amplify a design feature.

Fillet radii should be of appropriate size throughout.

- 2 Ensure that your drawings conform to the requirements of BS308/PD7308, include the recommended symbol for the method of projection you have used. [11]
- 3 Complete a parts list tabulating all the given parts, including the hexagonal headed bolts and washers. [4]
- 4 Draw to a suitable scale, in first or third angle projection, a detailed drawing of the PUMP ROD BEARING that satisfies design feature (iii). Dimension the drawing and include a suitable material.

Ensure your detail drawing is well clear of assembly views (a), (b) and (c). [7]

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