Faculté de génie
Génie mécanique

uOttawa
L'Université canadienne
Canada's university

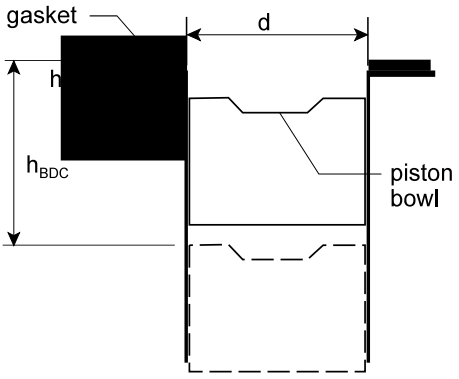
Faculty of Engineering
Mechanical Engineering

Name:_____ ID_____ Section_____

MCG 1100 - Dissection Lab 6 - Work Sheet
(To be handed in at the end of the lab period)

Note: please follow closely the dismantling procedure given in your lab manual, and answer the following questions after the steps specified.

The first question should be done at step 3(e) in the lab manual. The other questions are to be answered after dismantling is complete.



1. (3 marks) Estimate the compression ratio of the engine (*i.e.* the ratio of the cylinder volume at bottom dead centre (BDC) to that at top dead centre (TDC)). The cylinder volume is determined by measuring the diameter and the distance from the top of the cylinder (including the head gasket) to the piston using a vernier caliper. To this must be added the volume of the space in the cylinder head (determined by injecting measured amounts of water with the syringe) and the volume of the "bowl" in the piston crown.

(i) Cylinder diameter *d* *69.96* mm

(ii) Distance from head to piston at TDC h_{TDC} *1.6* mm

Cylinder volume (not including head or bowl) at TDC *6.2* ml
(*n.b.* 1 ml = 1 cm^3 = 1000 mm^3)

(iii) Distance from head to piston at BDC h_{BDC} *55.7* mm

Cylinder volume (not including head or bowl) at BDC *214* ml

(iv) Volume of piston bowl: 3.3 ml

(v) Volume of space in head (spark plug, valve spaces) *20* ml (measured with water)

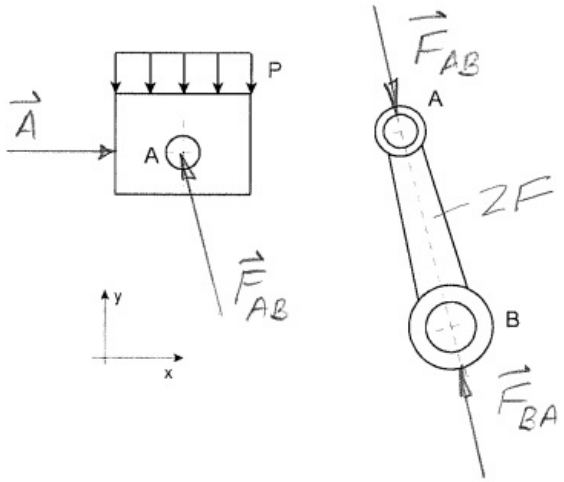
(vi) Total volume (cylinder + head space + bowl) at TDC *29.5* ml

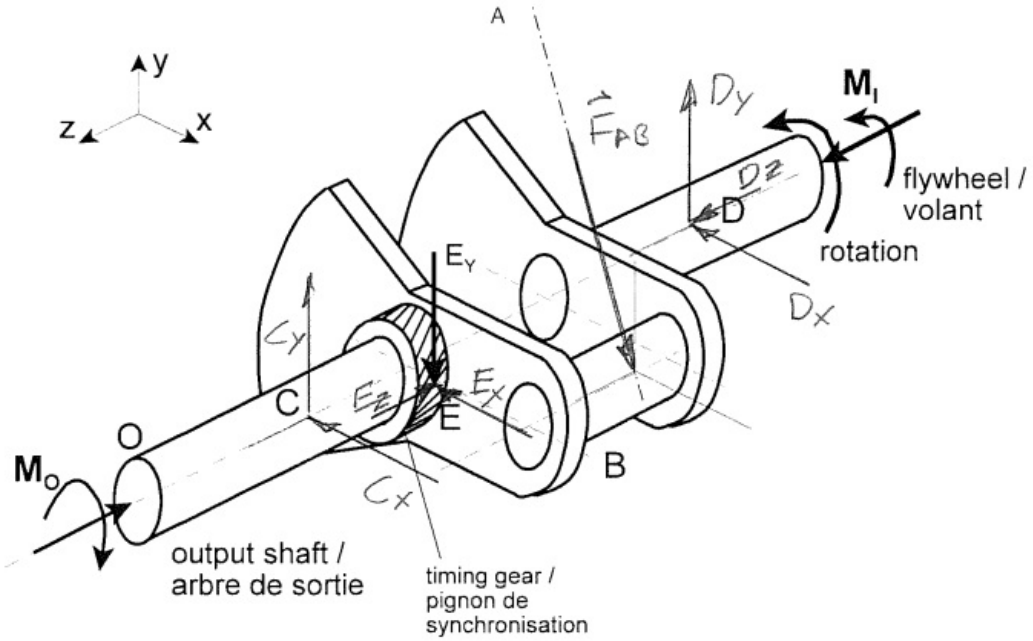
Total volume (cylinder + head space + bowl) at BDC *237* ml

Volumetric compression ratio $(V_{BDC}) / (V_{TDC})$ 8.1 : 1

The following questions should be done after completing the dismantling of the engine:

2. (6 marks) Complete the free-body diagrams of the piston, connecting rod, and crankshaft during the **compression** stroke. The crankshaft rotates in the direction shown. Assume that the engine is driving a load, whose resistance creates a reaction couple $\mathbf{M_o}$ at the output at O. During the compression stroke the engine and its load are driven by energy stored in the flywheel, giving rise to the input moment $\mathbf{M_I}$. Identify all two-force members, and include forces at bearings C and D as well as the forces on the timing gear at E. D can act as a thrust bearing. Neglect friction and the weights of the parts.





3. (1 mark) Using a micrometer, measure the shaft diameter at the point where the shaft passes through the ball bearing **in mm**.

Shaft diameter = *24.95* mm.

4. (3 marks) Give a complete specification (diameter, thread pitch, length, head style) of the following screws:

- cylinder head screws *M8 x 1.25 x 60*

- crankcase cover screws *M8 x 1.25 x 32*

- valve box cover screws *M6 x 1.0 x 12*

5. Identify the materials and manufacturing processes used for the following parts of the engine. Give reasons for your choices.

(a) (2 marks) crankcase (*i.e.* the main body of the engine)

material *aluminium (light weight, colour)*

manufacturing processes

die casting (lots of fine detail, metal has flowed long distances)
followed by facing (for cover), boring (bearing seats, cylinder bore), drilling and tapping (screw holes).

(b) (2 marks) crankshaft

material *steel (magnetic, colour)*

manufacturing processes

sand casting (rough finish - see crank web), followed by turning (cylindrical surfaces), facing (crank web), probably precision grinding (evidence - surface finish, no machining marks). Rough crankshaft could also have been produced by forging.

6. (3 marks - 1 mark each) Comment on the following design features:
(a) Why does the connecting rod have an I-shaped cross-section?

I section saves weight, puts most material in areas under greatest load in bending

(b) Note the keyway in the crankshaft for the key that fixes the flywheel in place. Why is the shaft tapered (*i.e.* conical in shape) at the point where the flywheel is attached?

Taper keeps flywheel precisely centred - it can be removed and replaced, yet still be exactly centred on shaft.

(c) How is the engine lubricated?

Bottom of crankcase is filled with oil, which is splashed into the engine mechanism by the arm on the crank bearing cap.