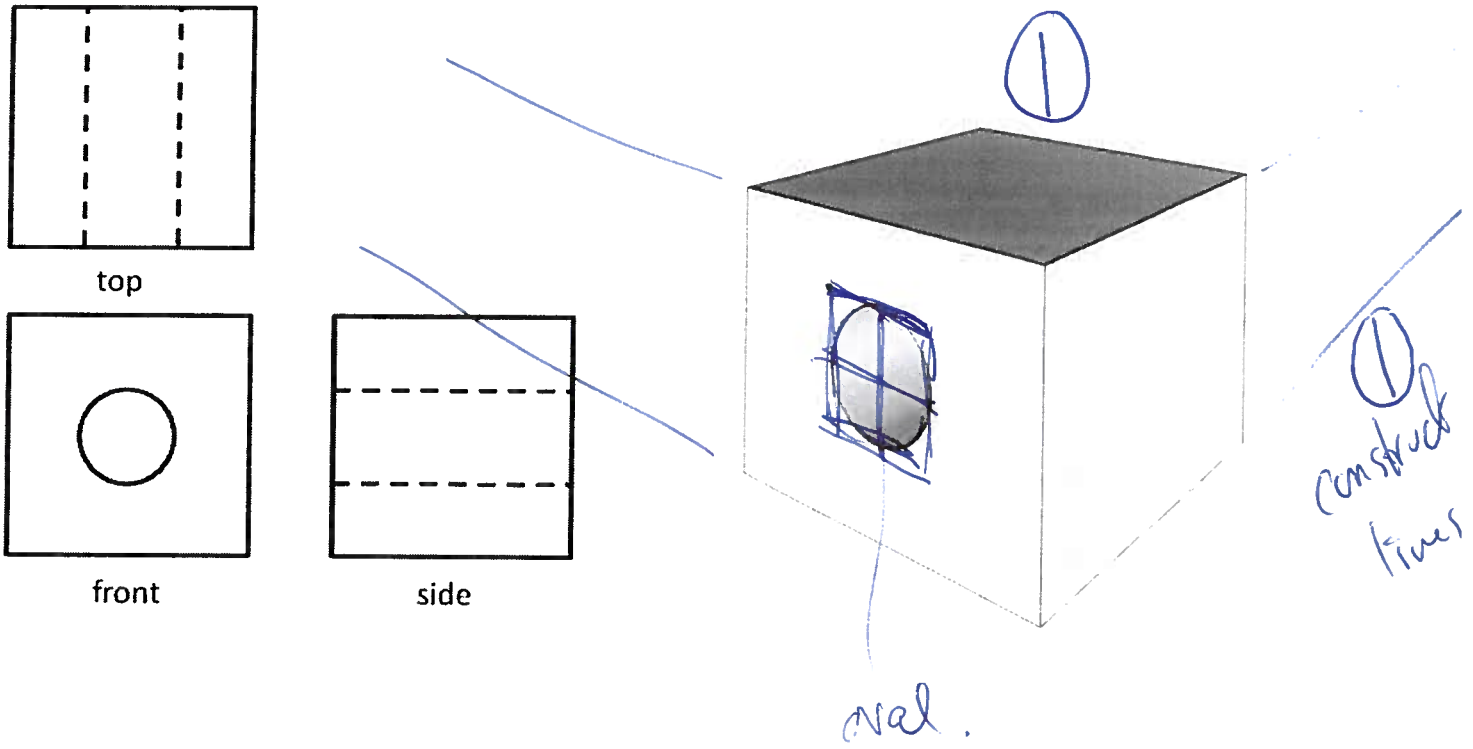
Name:_____ Student #:_____

Written Answer (marks per question as indicated on question; 18 marks total)

13. (3 marks) The diagram below is called a Multiview orthographic diagram.

Sketch a two-point perspective drawing of the block depicted below. Assume that it measures 5 cm x 5 cm x 5 cm and that it is sitting on the desk in front of you with three faces (top, front, and side) visible. Assume further that in the sketch, none of the faces is in the plane of the paper. Show construction lines if you use them.



Could add construction lines to this figure: Lines on the block edges converging on the two vanishing points 2) A bounding square around the circular hole with each side of the square bisected.

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The remaining questions (14 - 18) deal with the following problem statement:

You are asked to design an ice and snow scraper for cleaning a car windshield. It will have adjustable length, a snowbrush and windshield squeegee at one end, and a scraper at the other end. The existing product from a competitor is shown in the figure below and has all of these features. It is made from aluminum tubing, plastic molded parts, rubber, foam and nylon bristles. Your company would like to sell the new version at a hefty profit so your boss asks you to rethink the whole thing to minimize manufacturing costs and to maximize profitability.

14. (4 marks) Describe (briefly) two general principles of design for manufacturing and assembly, and indicate how you would use these principles to minimize manufacturing and assembly costs for the new, redesigned product.

Minimize the number of parts

- Mold the scraper and top section of tubing together out of plastic, and eliminate the foam.
- Make the bristles from nylon molded in one piece into the head of the brush.
- Mold the entire thing out of plastic except fro the rubber squeegee.

Make parts easy to assemble:

- Use standard parts
- Symmetric parts
- Bevel edges to make insertion easy
- Snap fits instead of screws (if there are any)

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15. (4 marks) The existing product has a stamp that says "US Patents 8,503,509 and D765098" What do these numbers signify and what do they mean for your design process?

8503509 is a utility patent protecting some aspect of the functionality.

Must read the claims to make sure that the new design does not infringe.

D765098 is a design patent protecting the look of the brush.

Must design a brush that looks different from the drawings in the patent (which presumably look like the brush itself)

16. (4 marks) The main tube on the existing product is made from aluminum, and your boss suggests using some type of injection-molded plastic to save money. Given a) that the plastic part would be injection molded, and b) the heavy loads put on the device when scraping ice from the windshield, what **challenges** might you face and **how would you address them.**

It is not feasible to injection mold long tubes. So a u-shaped channel is the best you can do, perhaps reinforced with diagonal ribs.

Plastic is much less stiff and strong than aluminum so the walls would have to be made much heavier.

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17. (2 marks) Even if the product works for the first year, long-term failure might be an issue. List two possible long-term failure modes for this product. Write one sentence for each one giving the name of the failure mode and how it might apply in this case.

Weathering UV deg.

Corrosion – the salt water could attack the alumimum. UV light attacks polymers.

Fatigue – crack grows slowly and eventually the part breaks.

Wear – the scraper blade eventually gets dull and worn away. all parts.

Creep – no constant load so creep is not a problem.

18. (1 mark) How could you apply the principles of industrial design to improve sales? Give an example of a specific design feature that you would use for this product.

One solution is to this product to look and feel tough and durable so customer will conclude that it will last. So we could use patterns and shapes evocative of heavy duty machinery.

- The plastic could have embossed "rivets" for example,
- Could emboss a carbon fibre pattern in the plastic to convey strength.

Any product feature that is non-functional, but is designed to appeal to the consumer is acceptable.

- Perhaps we want the brush to be used by children, and thus we would build in features to evoke a toy: bright coloured plastics, molded in characters
- Could make it look high tech using sleek curved surfaces, glossy textures etc.