The University of Melbourne
Semester 2 Assessment, 1999

Department of Mechanical and Manufacturing Engineering

436-105 ENGINEERING COMMUNICATIONS

Student Number: ………………..

Examination duration: 3 hours
Reading time: 15 minutes
This paper has: 10 pages

Authorised materials:
Electronic calculators and drawing instruments may be used.

Instructions to invigilators:
Candidates are to complete the examination by writing and drawing in this examination paper, which must be collected at the end of the examination. No additional script books should be required.

Instructions to students:
Attempt all of the five questions. All questions are of equal value.
Space is provided in this paper to complete all the questions. No additional script books should be required. The whole paper must be left for collection by the invigilators at the end of the examination.
Be sure to write your student number in the space provided above.

Library:
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Question 1

(a) In the following multiple-choice questions, select the one best answer by ticking the adjacent selection box (☐).

1. What is(are) the major difference(s) between perspective and parallel projection?
   □ (a) parallel projection can only be used with objects containing parallel edges
   □ (b) perspective projection gives a more realistic representation of an object
   □ (c) parallel projection is equivalent to a perspective projection where the viewer is standing infinitely far away
   □ (d) perspective projection can only be used for creating oblique and not isometric pictorial views
   □ (e) both (b) and (c) above

2. Which statement is true about the precedence of lines?
   □ a hidden line has precedence over a centre line
   □ a centre line has precedence over a visible line
   □ a visible line has precedence over a mitre line
   □ all of the above

3. Which of the following is typically represented in a drawing, but does not have a true physical counterpart on the object?
   □ edge of a planar surface
   □ edge of a circular face
   □ corner of a rectangle
   □ limiting element of a curved surface

4. All of the following are common parametric curves used to create surface patches, except:
   □ NURBS
   □ B-spline
   □ Bezier
   □ Boolean

5. Which type of Boolean operation creates a different result depending on which solid is listed first in the operation?
   □ union
   □ intersection
   □ difference
   □ all of the above

6. The selection of the front view when making a multiview drawing of an object is dependent on the following factors:
   □ size and shape of the object and their relationship to all views
   □ the number of principal views required and the related auxiliary views needed to describe the object
   □ the greatest contour shape, the related dashed lines, and the position of use
   □ the size of the object, size of the paper, position of use, and the least number of hidden lines
7. In orthogonal projection, *principal planes* will appear as:
- normal planes or edges
- oblique planes or edges
- normal planes or oblique planes
- skewed planes or edges

8. What two types of projection give a *pictorial* view of an object without convergence?
- orthographic and perspective
- oblique and axonometric
- perspective and oblique
- isometric and orthographic

9. A viewing direction which is *parallel* to the surface in question will give the following view of it:
- inclined
- normal
- edge
- perspective

10. Oblique planes in a three-view drawing will appear as
- two surfaces and one edge
- two edges and one surface
- three edges
- three surfaces

11. In the front view of a multiview drawing, a *horizontal surface* will appear as:
- an edge
- a normal surface
- a point
- a foreshortened surface

12. In a multiview drawing, which view is usually developed first, contains the least number of hidden lines, and shows the most contours?
- right side
- top
- back
- front

13. An axially symmetric object, such as one turned on a lathe, can normally be shown in how many views?
- one
- two
- three
- four
14. A title block normally contains all the following information except:

- name of the organisation responsible for the drawing
- parts list
- drawing sheet size letter designation
- drawing number

(b) Having studied the assembly drawing of the cylinder in figure 1, answer the following questions:

1. How is the Piston (part 4) secured to the Piston Cover (part 5)?
   *Four M6 × 1 × 30 Hex socket cap screws with lock washers*

2. How is the assembly of piston parts secured to the Piston Rod (part 6)?
   *By an M20 × 2.5 slotted nut and cotter pin*

3. To mount the cylinder assembly by its two legs, how far apart must the two mounting holes be? **200 mm**

4. What is the outside diameter of the Piston? **120 mm**

5. What is the thickness of the Leather Cups? **3 mm**

6. What is the maximum travel of the Piston in one direction? **119 mm**

7. What is the length of the Cylinder (part 7)? **175 mm**

8. What is the wall thickness of the Cylinder? **6 mm**

9. What is the inner diameter of the Packing Gland (part 3)? **25 mm**

10. What is the distance between the inlet and outlet orifices? **211 mm**

11. What size wrench would be required to tighten the Packing Gland? **45 mm**
Question 2

An isometric view of a cast iron bracket is shown in figure 2. **Draw** the following views in third-angle projection:

(a) a front view from A
(b) a side view from B
(c) a top view

Fully **dimension** the part, and **provide** a title block and appropriate information about the part and the drawing.

![Figure 2](image-url)
Question 3

Complete the front view in figure 3, showing the line of intersection between the objects.
**Question 4**

Figure 4 below shows part of a city plan. A water pipe AB under Clyde Street is to be connected to another water pipe CD under Naughton's Avenue. BC is horizontal, and both AB and CD slope downwards at an angle of 30° to the horizontal plane. Find the shortest pipe MN joining AB and CD, and show MN in plan and elevation views.
Question 5
Consider again the problem posed in question 4. This time, vector methods are to be used to find the shortest pipe MN.

As shown in figure 5, the point C is taken as the origin of an x-y-z coordinate system. The x- and y-coordinates of points A, B, C and D are given in the figure. Again, BC is horizontal, both BA and CD slope down at 30º to the horizontal, and MN is the shortest pipe joining AB and CD.

Use vector methods to find:
(a) the length of the shortest pipe MN
(b) the coordinates of the points M and N

Hint: Recall that the shortest distance between two lines that are defined, respectively, by a position vector $\mathbf{r}_1$ and unit vector $\mathbf{u}_1$, and a position vector $\mathbf{r}_2$ and unit vector $\mathbf{u}_2$, is given by

$$
(r_1 - r_2) \cdot \frac{\mathbf{u}_1 \times \mathbf{u}_2}{|\mathbf{u}_1 \times \mathbf{u}_2|}
$$

Figure 5

Let shortest pipe be MN where M is on CD and N is on AB.
Then, position vector of N is $\mathbf{r}_N = \mathbf{r}_B + B\mathbf{u}_1$, say, where $\mathbf{u}_1$ is unit vector along BA, and $\mathbf{r}_M = \mathbf{r}_C + C\mathbf{u}_2$, say, where $\mathbf{u}_2$ is unit vector along CD.
We have $\mathbf{r}_B = (99.1, 56.4, 0)$ and $\mathbf{r}_C = (0, 0, 0)$.

(Continue calculations on next page)
Worksheet for question 5

Unit vectors:

\[ \mathbf{u}_1 = \left( \frac{-60.1 -99.1}{163.53}, \frac{93.8 -56.4}{163.53} \right) = (-0.843, 0.198, -0.500) \]

\[ \mathbf{u}_2 = \frac{\mathbf{CD}}{|\mathbf{CD}|} = \frac{(118.8, -66.6, -78.6)}{157.3} \]

i.e., \[ \mathbf{u}_2 = (0.755, -0.424, -0.500) \]

A vector normal to both pipes BA and CD is \[ \mathbf{U} = \mathbf{u}_1 \times \mathbf{u}_2 = (-0.311, -0.799, 0.207) \].

Thus, unit vector along shortest distance pipe is \[ \mathbf{u} = \frac{\mathbf{U}}{|\mathbf{U}|} = \frac{\mathbf{U}}{0.882} \]

i.e., \[ \mathbf{u} = (-0.352, -0.906, 0.235) \]

\[ \text{Similarly, } \mathbf{u}_1 = \frac{\mathbf{CD}}{|\mathbf{CD}|} = \frac{(118.8, -66.6, -78.6)}{157.3} \]

Hence, \[ \mathbf{r}_M = \mathbf{r}_C + \mathbf{CMu}_2 = \mathbf{r}_B + \mathbf{BNu}_1 - \mathbf{MNu}_2 \].

\[ \text{Hence, } (\mathbf{r}_B - \mathbf{r}_C) \cdot \mathbf{u} = \mathbf{MN}, \text{ since } \mathbf{u}_1 \cdot \mathbf{u} = \mathbf{u}_2 \cdot \mathbf{u} = 0. \]

That is (since \( \mathbf{r}_C = 0 \)),

\[ \mathbf{MN} = |\mathbf{r}_B \cdot \mathbf{u}| = |(99.1, 56.4, 0) \cdot (-0.355, -0.906, 0.235)| \]

i.e., \[ \mathbf{MN} = 86.0 \] \( \text{##(a)##} \)

Also, from (1)\( \cdot \mathbf{u}_2 \),

\[ \mathbf{CM} = \mathbf{r}_B \cdot \mathbf{u}_2 + \mathbf{BNu}_1 \cdot \mathbf{u}_2 \]

i.e., \[ \mathbf{CM} = 50.98 - 0.471\mathbf{BN} \] \( \text{(i)} \)

and, from (1)\( \cdot \mathbf{u}_1 \),

\[ \mathbf{CMu}_2 \cdot \mathbf{u}_1 = \mathbf{r}_B \cdot \mathbf{u}_1 + \mathbf{BN} \]

i.e., \[ \mathbf{BN} = -0.471\mathbf{CM} + 72.38 \] \( \text{(ii)} \)

Solving (i) and (ii) \( \Rightarrow \mathbf{CM} = 21.72, \mathbf{BN} = 62.15 \).

Hence, \[ \mathbf{r}_M = \mathbf{CMu}_2 = 21.72 \times (-0.755, -0.424, -0.500) \]

i.e., \[ \mathbf{r}_M = (16.4, -9.2, -10.9) \] \( \text{##(b)##} \)

and \[ \mathbf{r}_N = \mathbf{r}_B + \mathbf{BNu}_1 = (99.1, 56.4, 0) + 62.15 \times (-0.843, 0.198, -0.500) \]

i.e., \[ \mathbf{r}_N = (46.7, 68.7, -31.1) \] \( \text{##(b)##} \)

(Continue calculations on back of page if you need more room)

End of examination