National Examinations – May 2012

98-Civ-B10, Traffic Engineering

3 Hour Duration

NOTES

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.

2. Any data required, but not given, can be assumed.

3. This is an **"OPEN BOOK"** examination. Any non-communicating calculator is permitted.

4. A total of **five** solutions is required. Only the first five as they appear in your answer book will be marked.

5. All questions are of equal value.

1. (a) Determine the minimum stopping sight distance on a +2.5 % grade at a design speed of 100 km/h. Assume a reaction time of 2.5 s and a coefficient of longitudinal friction of 0.29.

(b) A freeway accommodates 4000 vehicles during the peak hour. The traffic count at the twelve 5-minuter intervals during the peak hour is as shown:

400, 300, 200, 600, 500, 400, 300, 600, 200, 200, 100, 200

Compute the peak hour factor based on 15-minute interval.

2. (a) Compute the minimum length of vertical curve that will provide 130 m stopping sight distance for a design speed of 80 km/h at the intersection of +2.5 % grade and -4.5 % grade.

(b) Calculate the space-mean speed of a traffic stream of 12 vehicles given the following:

Three vehicles travel at 30 km/h
Four vehicles travel at 40 km/h
Five vehicles travel at 50 km/h

3. A ramp meter operates during the morning peak period, whose cycles vary with time as shown in the following table. The metering scheme allows one vehicle to pass the signal per cycle. Using the information given, draw a queuing diagram and determine the maximum queue, the maximum delay for any vehicle and the total delay.

Time period	15-minute volume	Cycle length, s
6:00 a.m. – 6:15 a.m.	80	10
6:15 – 6:30 a.m.	100	10
6:30 -6:45 a.m.	120	12
6:45 – 7:00 a.m.	110	12
7:00-7:15 a.m.	90	10
7:15 – 7:30 a.m.	70	8

4. Calculate the mean, standard deviation and the standard deviation of the mean for the spot speed distribution below. Plot the cumulative distribution curve and determine the 90th percentile speed.

Mid-point of the speed group, km/h	Frequency observed
40.0	1
45.0	1
50.0	4
55.0	10
60.0	18
65.0	21
70.0	23
75.0	22
80.0	12
85.0	5
90.0	2
95.0	1

5. (a) Given the jam density is 100 vehicles/km and the free-flow speed is 100 km/h, compute the maximum rate of flow, assuming linear speed-density relationship

(b) A highway at a particular instance has a jam density of 100 vehicles/km. Calculate the mean space headway. Also calculate the density at maximum flow, assuming linear speed-density relationship.

(c) A highway has a design hour volume of 1600 vehicles. Calculate the mean time headway.

(d) What is the theoretical maximum peak hour factor based on 15-minute interval?

6. (a) Vehicles arrive at an entrance to a recreational park at an average arrival rate of 180 vehicles/hour and the arrivals are exponentially distributed. If the time required to distribute the brochure is 15 seconds, compute the average length of queue (i.e., the number of vehicles waiting in line), average waiting time in the queue and the average waiting time spent in the system.

   (b) Define the following:

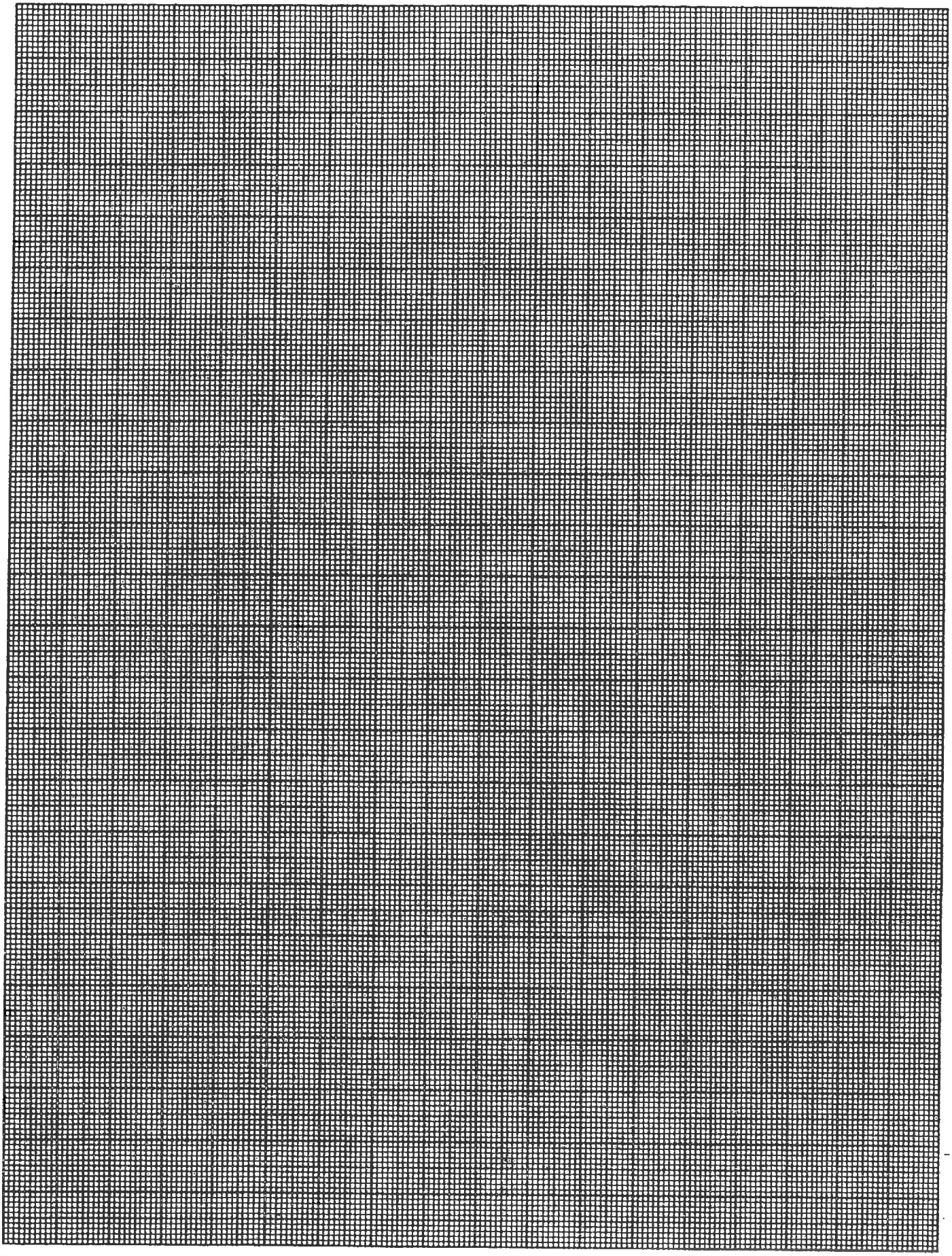
   (i) Average running speed
   (ii) Average travel speed
   (iii) Headway factor (in connection with two-lane highways)
   (iv) AADT
   (v) DHV

7. For a two-way street in a downtown area, design graphically a traffic signal system, given the following:

   Seven intersections: A, B, C, D, E, F and G
   The intersections are equally spaced with a spacing of 500 m.
   Traffic signals at intersections A, C, F and G only.
   No traffic signals at intersections B, D and E.
   Cycle length = 60 seconds
   Green time = 30 seconds.
   Desired progression speed = 60 km/h (both directions)

   Clearly indicate

   (a) the through band in each direction
   (b) the band widths, and
   (c) the signal timing offsets, with reference to master signal at A.



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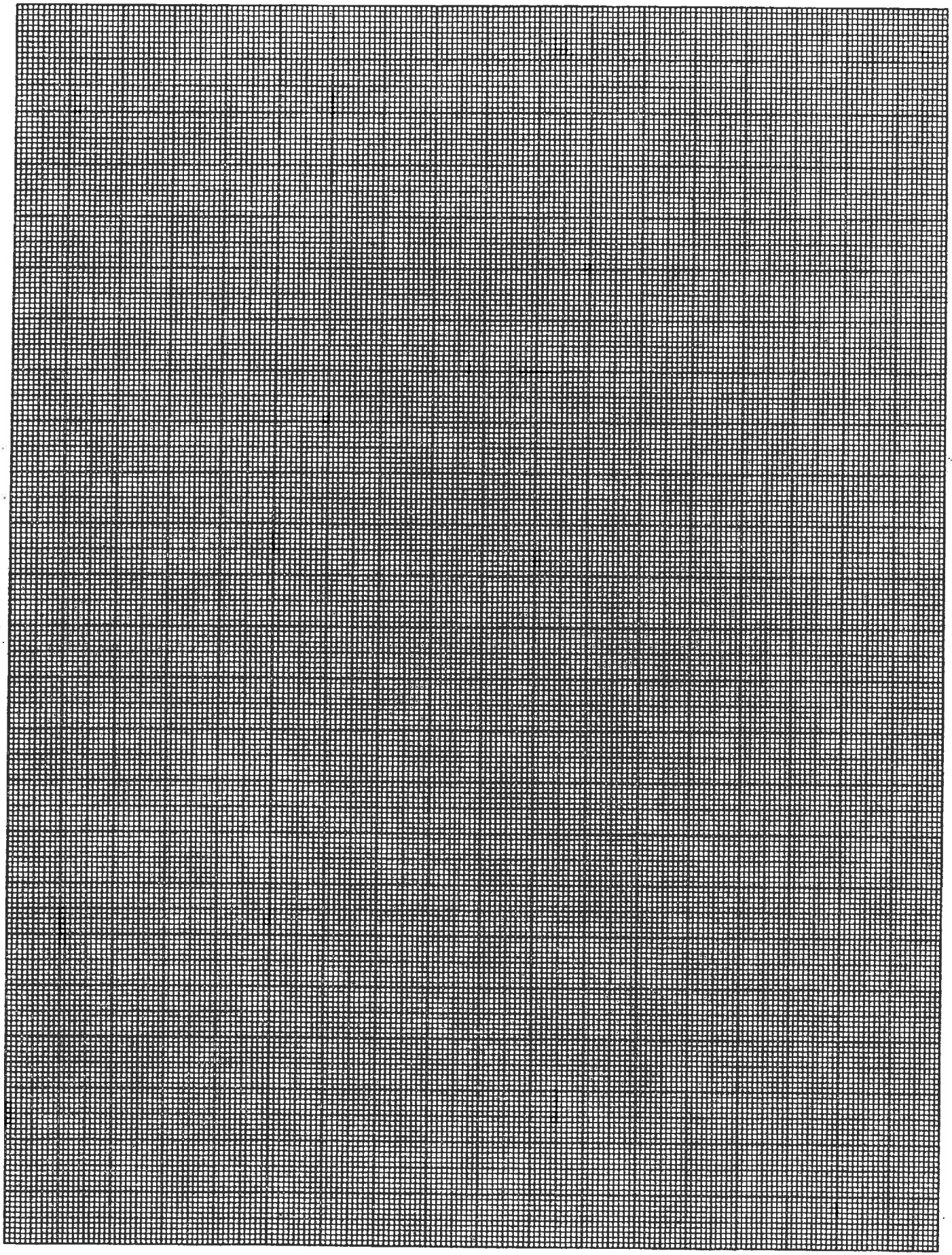

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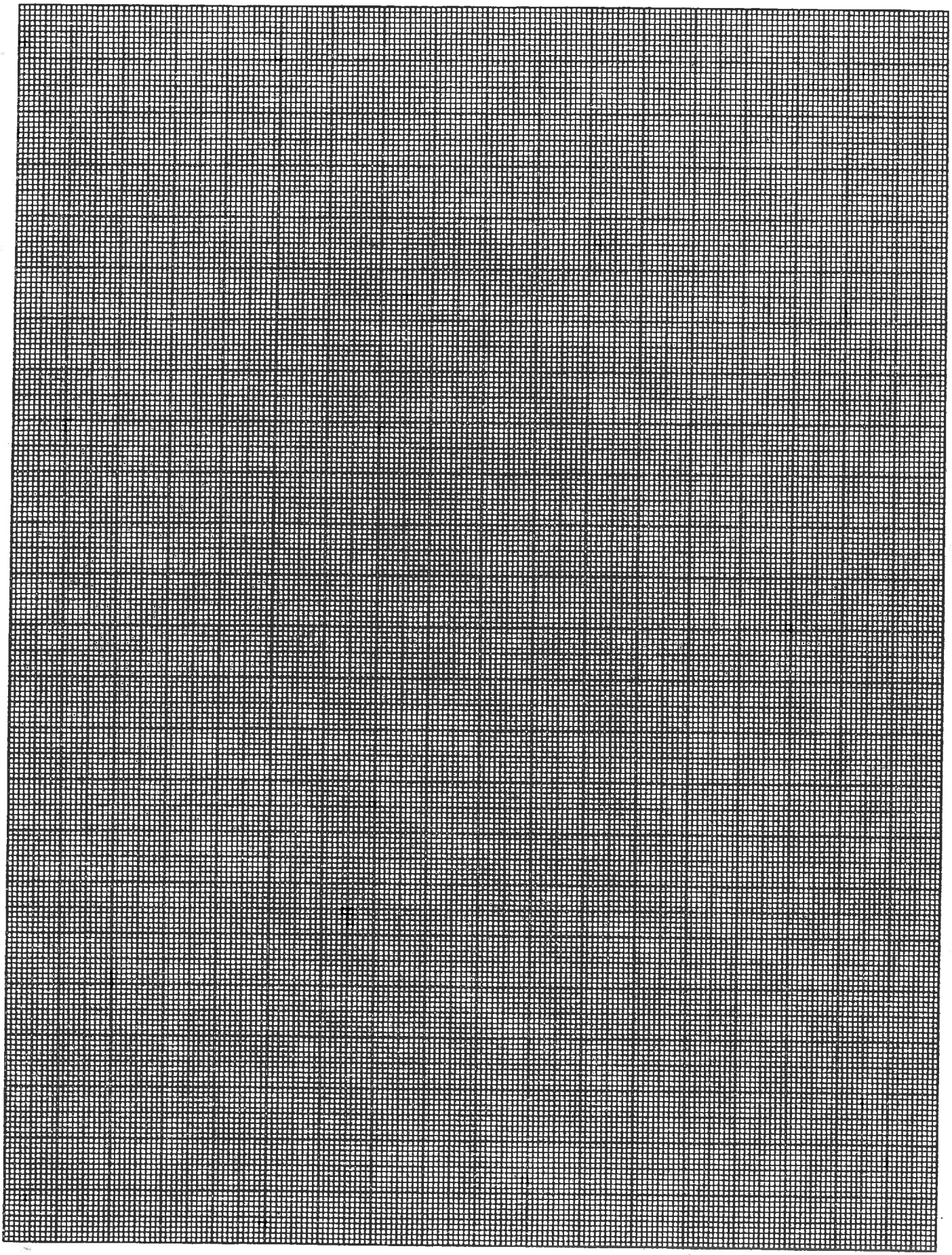

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Grading Scheme

1. (a) 10 marks
   (b) 10 marks

2. (a) 12 marks
   (b) 8 marks

3. 20 marks

4. 20 marks

5. Each part is 5 marks; total 20 marks.

6. (a) 10 marks
   (b) 10 marks

7. (a) 6 marks
   (b) 7 marks
   (c) 7 marks