National Examinations – December 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. An approach to a signalized intersection has a saturation flow of 1700 vehicles per hour. The length of the cycle is 60 seconds of which the effective green is 30 seconds. During three consecutive cycles, 13, 9 and 5 vehicles arrive.

(a) Draw the queuing diagram assuming D/D/1 queuing. (deterministic arrivals, deterministic departures and one departure channel).
(b) Determine the total vehicle delay over the three cycles.

2. The north-south streets of a central business district have block lengths f 125 m and east-west streets have block lengths of 250 m. Desired speeds of progression in both directions are 40 km/h.

(a) Determine whether single alternate, double alternate or triple alternate signal system is appropriate to obtain the desired result. Round the cycle length to the nearest 5 seconds. Determine the actual speeds of progression.
(b) Graphically show the through band and band width.

3. (a) Determine the minimum stopping sight distance on a +5% grade at a design speed of 100 km/h, assuming friction of 0.29. Assume a reaction time of two seconds.

(b) Four race cars are travelling on a 4-km oval track at constant speeds of 320 km/h, 310 km/h, 300 km/h and 290 km/h. For an observer standing at a point on the track for 30 minutes, what is the time-mean speed and space-mean speed for these vehicles?

4. A spot speed study is conducted on an approach to an accident-prone intersection. Prior to the posting of warning signs, a sample of 100 speeds has a mean of 60 km/h with a standard deviation of 8 km/h. After the warning signs are posted, a sample of 90 speeds has a mean of 55 km/h with a standard deviation of 7.5 km/h. Is the decrease in mean speed statistically significant at a level of significance of 0.05?

5. (a) Given rural two-lane highway with 3.75 m wide lanes, 3 m shoulders, overall long section in level terrain, ideal alignment with an average highway speed of 120 km/h, 100% passing opportunity, 6% trucks. If the DHV is 1900 vehicles/hour, determine the level of service provided.

(b) Given urban 6-lane freeway with 3.75 m wide lanes, 1.5 m wide shoulder on the right and 0.5 m wide shoulder on the left, 3% grade 1.5 km long, 4% trucks, 1% intercity buses, PHF = 0.91, average highway speed of 100 km/h, determine the service volumes at levels of service C and E.

6. A toll-booth on a turnpike opens at 8.:00 a.m. Vehicles start arriving from 7:45 a.m. (i.e. the queue starts at that time) at a uniform rate of 6 per minute until 8:15 a.m. and from then on at the rate of two per minute. If vehicles are processed at a constant rate of 6 per minute, determine
(a) when the queue will dissipate,
(b) the total delay, and
(c) the maximum queue length (in vehicles).

7. (a) Distinguish between

(i) Average running speed and average travel speed
(ii) Headway factor (in connection with two lane highways) and peak hour factor
(iii) Design hour volume and average annual daily traffic
(iv)Time-mean speed and space-mean speed

(b) Assuming linear speed-density relationship, if the jam density is 200 vehicles per km, and free-flow speed is 120 km/h, calculate the density at maximum flow, speed at maximum flow and the maximum volume of traffic.

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Grading Scheme

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

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

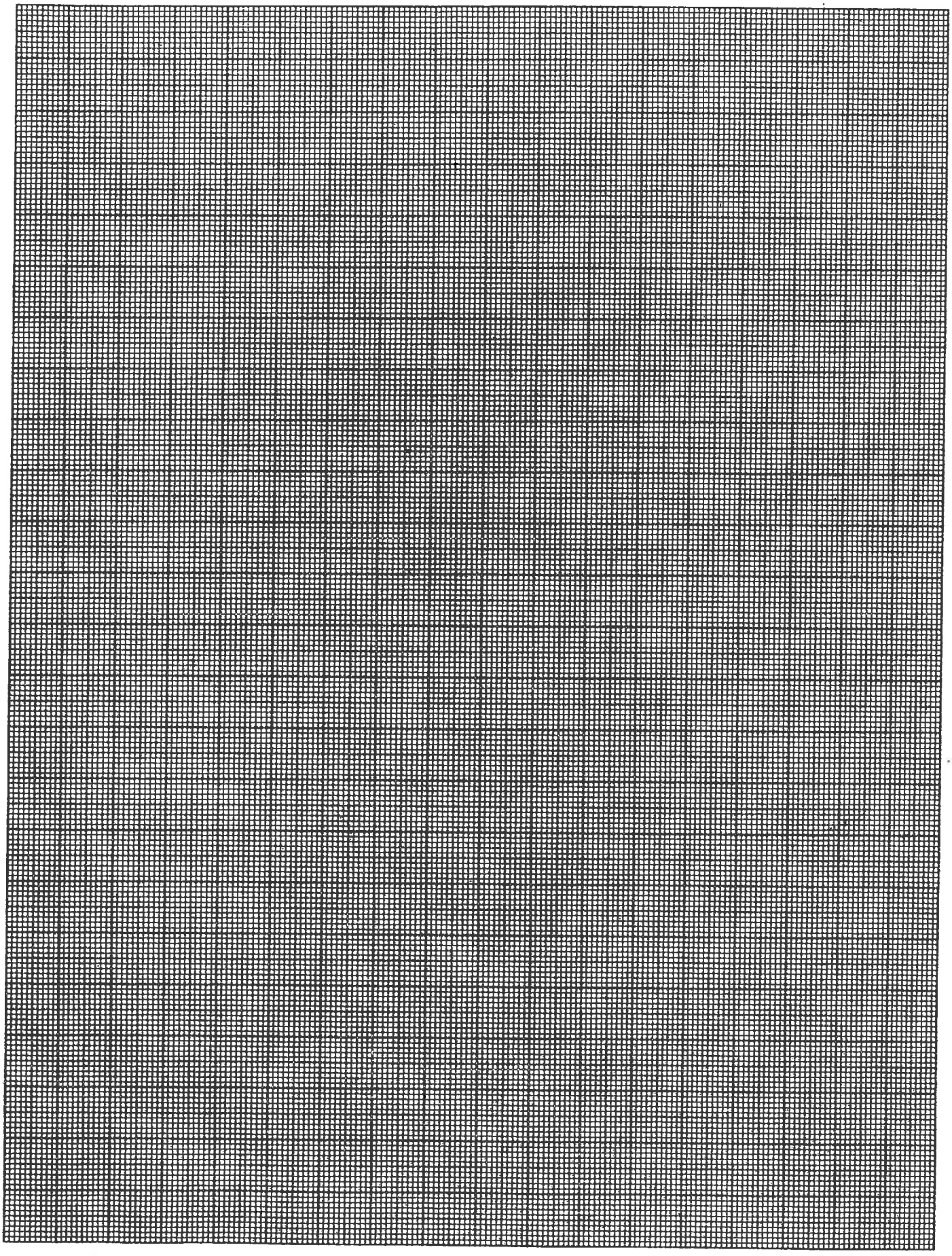
3. (a) 10 marks
   (b) 10 marks

4. 20 marks

5. (a) 10 marks
   (b) 10 marks

6. (a) 8 marks
   (b) 8 marks
   (c) 4 marks

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



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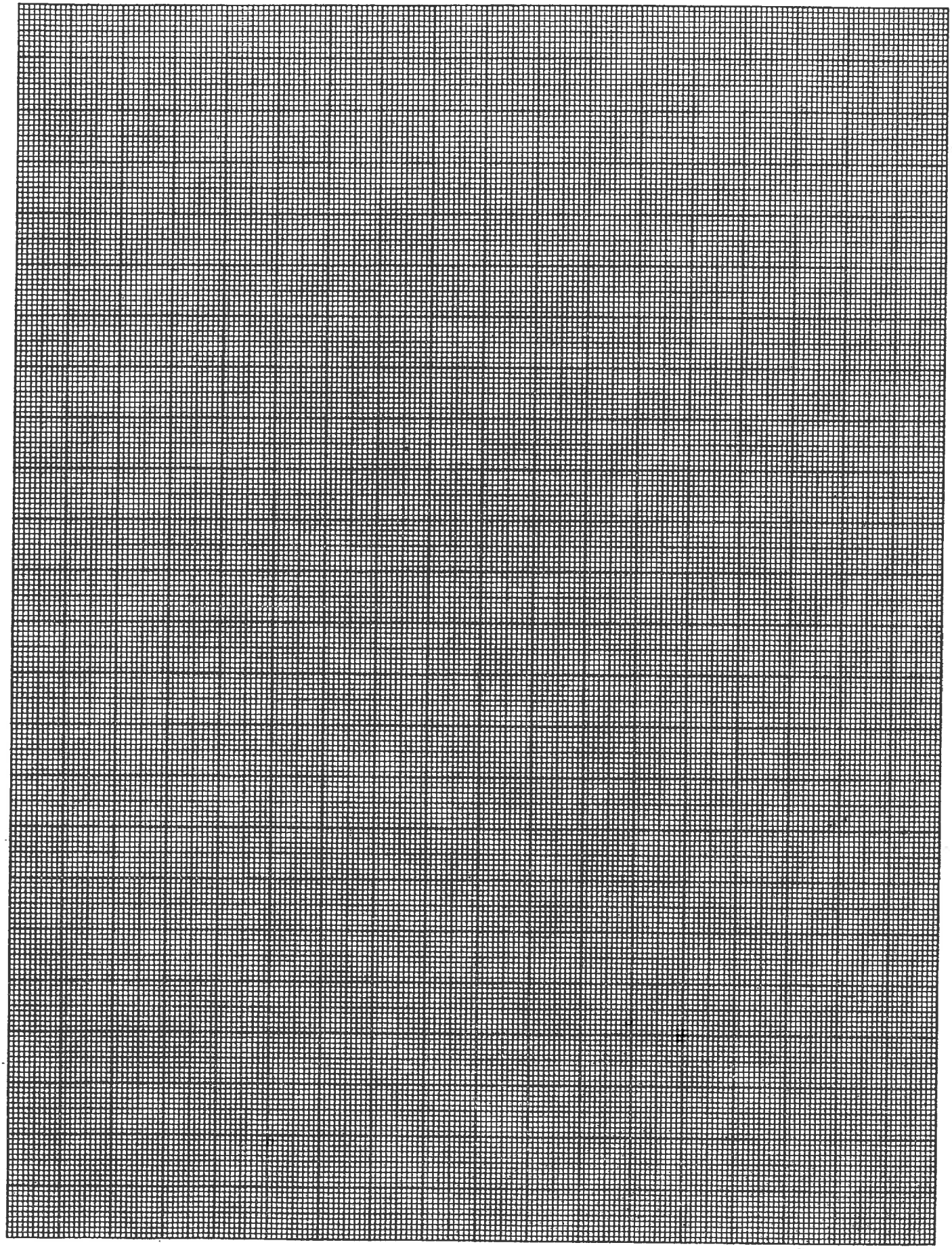

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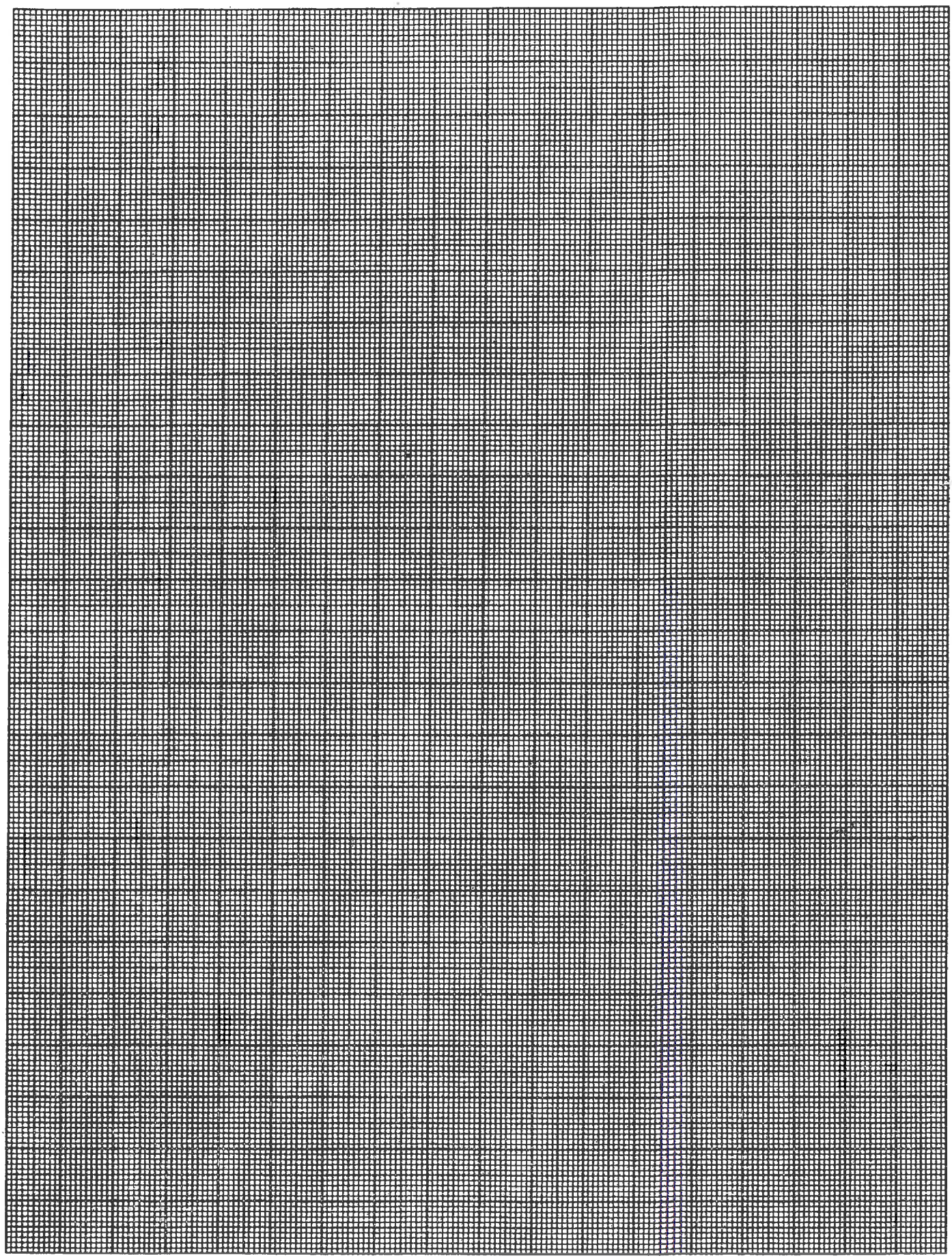

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