National Exams December 2019

17-Pet-A5, Petroleum Production Operations

(Duration 3 hrs)

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. This is an OPEN BOOK EXAM.
   Any non-communicating calculator is permitted.

3. FOUR (4) questions constitute a complete exam paper.
   The first four questions as they appear in the answer book will be marked.

4. Each question is of equal value.

Question #1

a-) A well is producing from reservoir having an average reservoir pressure of 4350 psig. A stabilized production test on the well resulted in producing rate of 680 STB/day when the flowing bottomhole pressure was 3000 psig. The bubble point pressure is 4400 psig. Using Vogel's method, determine the complete inflow performance relationship for this reservoir. (Assume S=0)

b-) Flow after flow test was conducted on a well producing from the same reservoir as described in part a. The test results were:

q_o, STB/Day	P_{wf}, psig
500	3400
680	3000
1000	2300
1500	500

Construct the IPR curve using Fetkowich method. Compare the results with the ones from part a.

q_o = oil production rate, STBO/Day

P_{wf} = Flowing bottomhole pressure, psig

Question #2

Average Reservoir Pressure :	P_R	= 4000 psig
Wellbore Radius:	r_w	= 0.3 ft
Drainage Radius:	r_e	= 1500 ft.

Two stabilized test data obtained at the current reservoir condition given as follows:

P_{WF}, psig	Q_{oil}, STB/Day
3400	1000
2500	2330

a-) Determine the flow efficiency factor, FE ?

b-) Determine the maximum possible oil production rate (AOF) when FE=1

c-) After performing a hydraulic fracturing job, a pressure transient test was conducted and the skin factor, S' , was found to be equal to -1.3 determine the flow efficiency. What is the Folds of Increase (FOI)? Is this a successful frac job? Explain!

d-) Construct the IPR curves representing the reservoir performance before and after the fracturing operation.

Question #3

Design a continuous gas lift operation for the following well;

Depth of Well : 8000 ft
Productivity Index J = 1 bbl/day/psi
Average Reservoir Pressure= 3000 psi
Desired Oil Production Rate: 1000 STB/day
Oil Gravity = 35°API
Gas Gravity = 0.65
No water is produced
Formation Gas Liquid Ratio = 100 SCF/STBL
Bottomhole Temperature = 200 °F
Surface Temperature= 100 °F
Tubing Wellhead Pressure: 160 psi
Tubing ID = 2.441 in.
Load Fluid gradient = 0.5 psi/ft
Static liquid level is at the surface
Valves will be 1 ½" retrievable
Differential Pressure Across Operating valve = 100 psi
Surface Gas Operating Injection Pressure = 1200 psi
Surface Gas Injection Kick-off Pressure = 1250 psi

Determine:
a-) Depth of Gas Injection
b-) Required Gas injection rate

Question #4

Depth of Well : 8000 ft
Productivity Index J = 1 bbl/day/psi
Average Reservoir Pressure= 3000 psi
Oil Gravity = 35°API
Gas Gravity = 0.65
No water is produced
Formation Gas Liquid Ratio = 100 SCF/STBL
Bottomhole Temperature = 200 °F
Surface Temperature= 100 °F
Tubing Wellhead Pressure: 160 psi
Tubing ID = 2.441 in.

The well described above is going to be equipped with ESP (Electrical Submersible Pump) set at 7000 ft from the surface. Assume that the casing ID below the pump is 6 in. If one half of the free gas is separated at the pump and the well is to produce at a total liquid rate of 1200 STBL/DAY, determine the required ESP horsepower.

Assume that reservoir fluid flowing pressure gradient (psi/ft) in casing is given by:

$dP/dL = 0.0001*q$

q = the total liquid flow rate, STBL/day

dP/dL = Flowing fluid pressure loss gradient in casing, psi/ft

Question #5

The following data pertaining to a well producing from a reservoir with a weak water drive were obtained from a material balance calculation and a PVT analysis. The reservoir pressure at the present time is 3000 psig and from a current test $q_{0(max)} = 2000\,STB/day$. Using Standing's method for generating future IPR's, determine the oil producing capacity of the well when the reservoir pressures falls down to 1500 psi.

API = 35°
Depth = 8000 ft
$q_{o(max)} = 2000\ STB/day$
$\gamma_g = 0.65$

$P_{wh} = 160$ psig
Tubing Size = 2 7/8 in. (ID = 2.441 in.)
$\bar{P}_{RP} = 3000$ psig

$\bar{P}_R$	μ_o, cp	B_o, bbl/STD	k_{ro}	GOR, scf/STB	f_w
3000	3.0	1.18	0.85	200	0
1500	3.70	1.12	0.60	800	0.5

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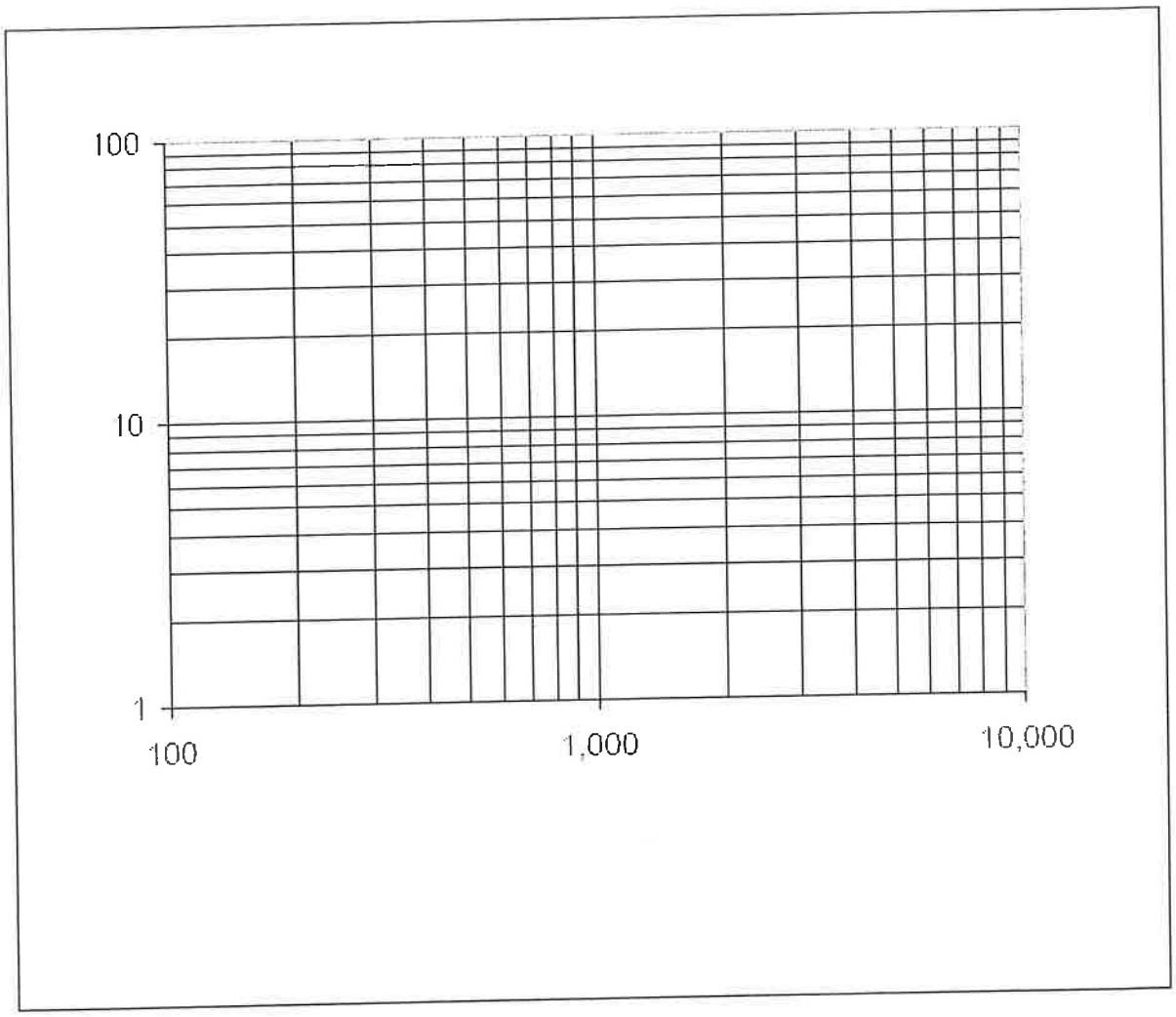
f_w = water cut
k_{ro} = relative permeability of oil
γ_g = gas gravity

P_{wh} = Wellhead pressure, psig

$\bar{P}_{RP} = average\ reserveoir\ pressure (at\ present)$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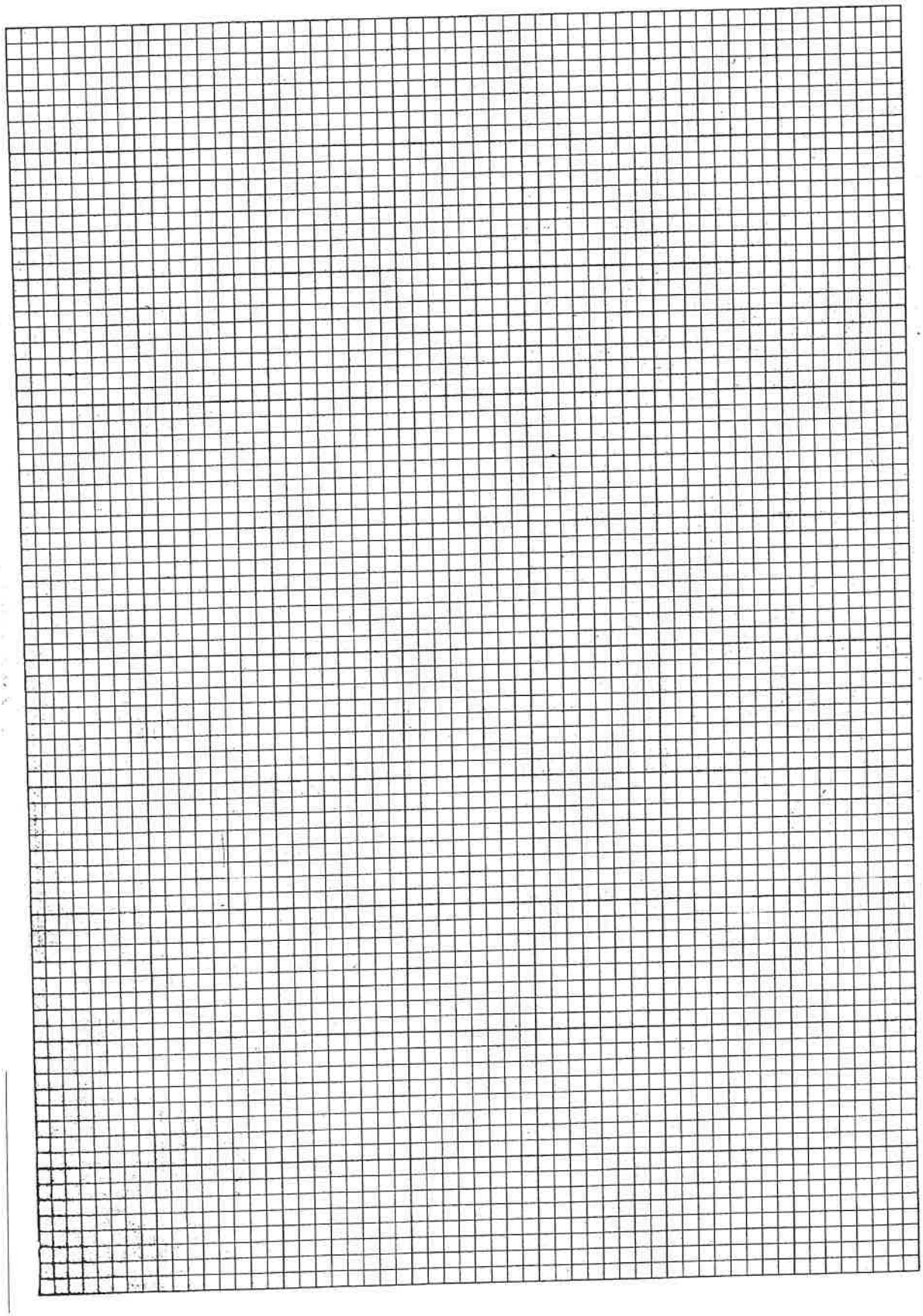

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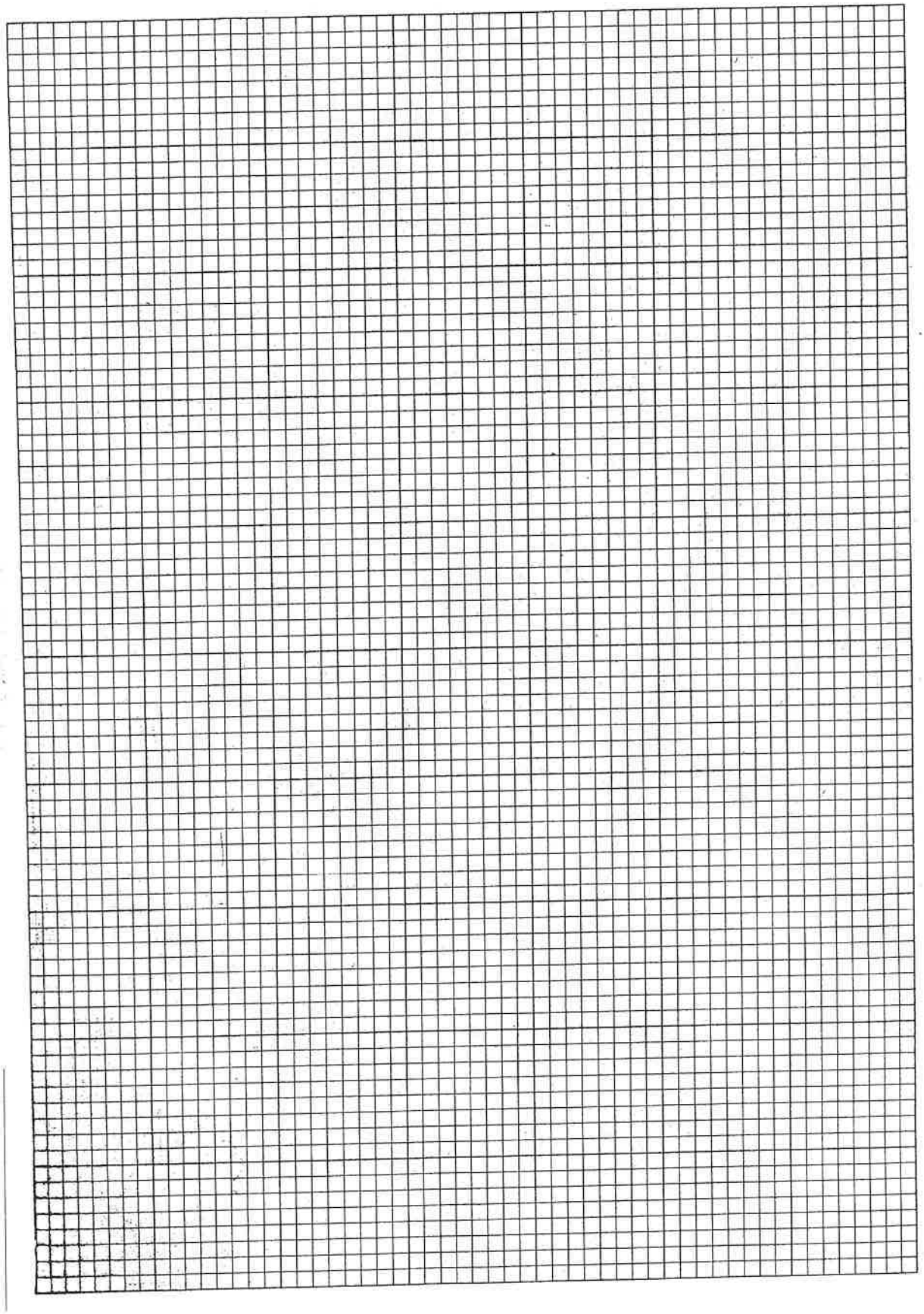

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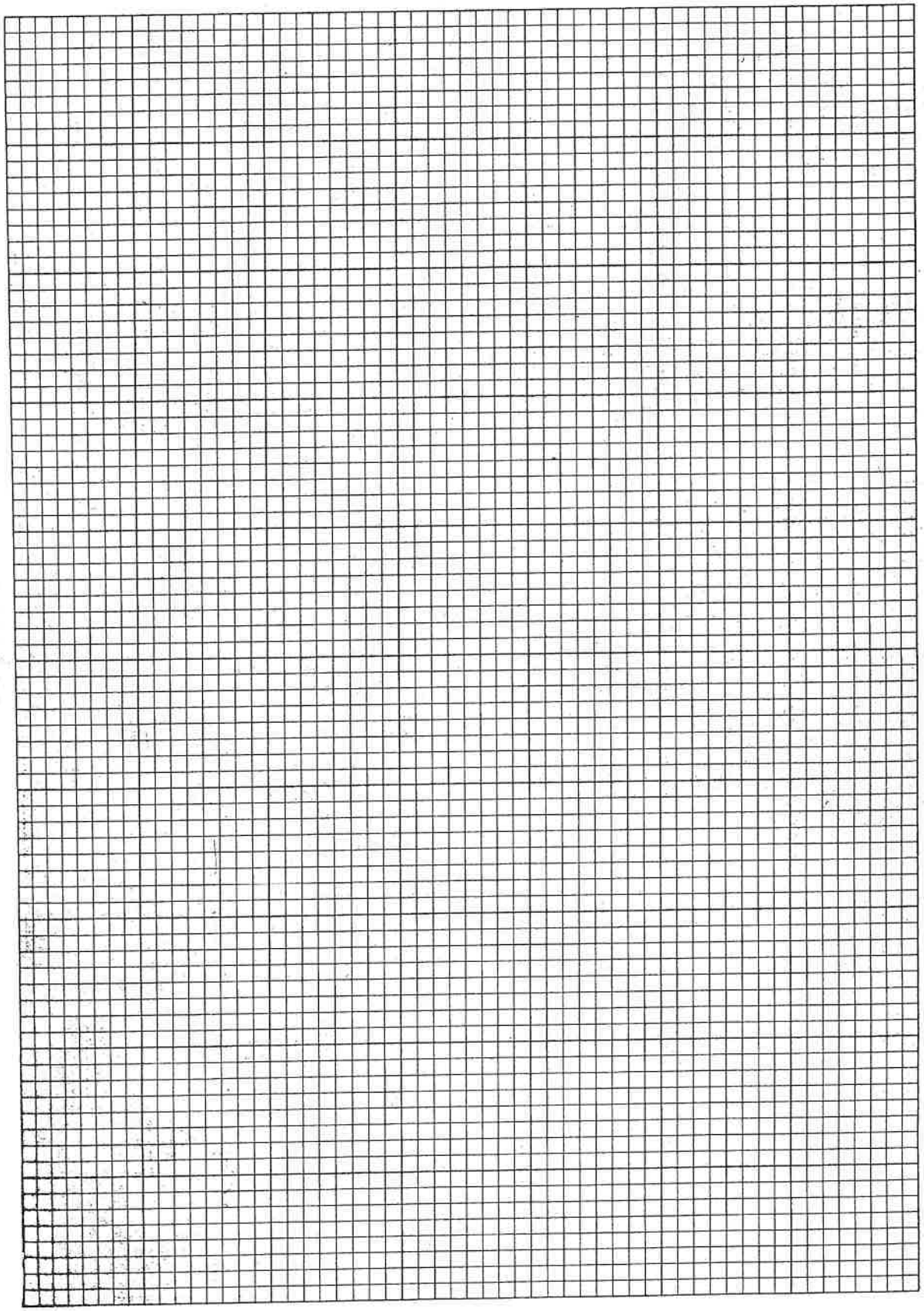

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