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ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව / இலங்கைப் பரீட்சைத் திணைக்களம் / Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 1998 අගෝස්තු (නව නිර්දේශය)
கல்விப் பொதுத் தராதரப்பத்திர(உயர் தர)ப் பரீட்சை, 1998 ஓகஸ்ற் (புதிய பாடத்திட்டம்)
General Certificate of Education (Adv. Level) Examination, August 1998 (New Syllabus)

රසායන විද්‍යාව I
இரசாயனவியல் I
Chemistry I

02 E I

පැ දෙකයි / இரண்டு மணித்தியாலங்கள் / Two hours

Important : This question paper consists of **two** sheets. Put the sheets together in the correct **order of pages before** answering.

*Enter your **Index Number** in the space provided on the answer sheet.*

*Use of calculators is **not** allowed.*

*You should attempt **all** the questions in this paper. For each question there are five responses of which only **one** is correct. When you have selected the response which you consider to be the best answer to a question, mark your response on the answer sheet. Answer easier questions first and leave aside any questions which you find too difficult and come back to them later.*

Universal gas constant, $R = 8{\cdot}314\ \text{J K}^{-1}\ \text{mol}^{-1}$

N.B. The following abbreviations have been used.

aq = aqueous
C = Celsius or Centigrade or Coulomb
g = gas
l = liquid
mol dm^{-3} = moles per cubic decimetre
s = solid

Other abbreviations also follow standard usage.

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1. The number of electrons in the last sub-energy level of the +4 cation formed from the element of atomic number 43 is
   (1) 1. (2) 2. (3) 3. (4) 4. (5) 5.

2. Which one of the following statements concerning the shape of the ClO_3^- anion is most appropriate?
   (1) It is tetrahedral.
   (2) It is planar.
   (3) It takes the shape of the letter 'T'.
   (4) It is trigonal pyramidal.
   (5) It has the shape of the SO_3 molecule.

3. In which one of the following molecules is the dipolar nature least?
   (1) H_2S (2) PH_3 (3) AsH_3 (4) H_2Se (5) BF_3

4. Which one of the following statements concerning nitrogen is most likely to be **false**?
   (1) NCl_3 exists (2) NF_3 exists (3) NO_2^+ exists (4) NF_5 exists (5) N_2H_4 exists

5. The chemical formula of radium manganate(VII) is
   (1) $RA(MnO_4)_2$. (2) $Ra(MnO_4)_2$. (3) $RAMnO_4$. (4) $RaMnO_4$. (5) $Re(MnO_4)_2$.

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6. Which one of the following is present in apatite?
   (1) $Ca_2Mg(PO_4)_3Cl$ (2) $Ca_2(PO_4)Cl_2$ (3) $CaMg_2(PO_4)F$
   (4) $Ca_3(PO_4)_5Cl$ (5) $Ca_5(PO_4)_3Cl$

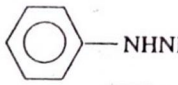
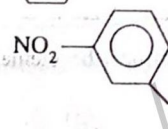
7. Which one of the following statements concerning CH_3OH and $(CH_3)_2CHOH$ is most appropriate?
   (1) These two compounds can be qualitatively distinguished using PCl_5.
   (2) These two compounds can be qualitatively distinguished using CH_3COCl.
   (3) These two compounds can be qualitatively distinguished using $K_2Cr_2O_7/H_2SO_4$ and Brady's reagent.
   (4) These two compounds can be qualitatively distinguished using aqueous $Ba(OH)_2$ and Fehling's solution.
   (5) These two compounds cannot be qualitatively distinguished using any of the above.

8. Consider the equilibrium reaction

$$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g) \quad \Delta H^{\ominus} < 0$$

Which one of the following will decrease the NO_2 concentration of the equilibrium mixture?
   (1) Increasing the NO concentration.
   (2) Increasing the temperature at constant pressure.
   (3) Decreasing the volume of the mixture at constant temperature.
   (4) Increasing the O_2 concentration.
   (5) Increasing the partial pressure of NO at constant temperature.

9. Which one of the following statements concerning bromine is most appropriate?
   (1) Bromine gas reacts with aqueous KOH and gives KBrO.
   (2) Bromine water reacts with KOH and gives $KBrO_3$.
   (3) Bromine gas reacts with aqueous KOH and gives KBrO and $KBrO_3$.
   (4) Bromine gas reacts with aqueous KOH and gives KBrO and KBr.
   (5) Bromine water reacts with KOH and gives KBr.

10. For the purpose of distinguishing qualitatively between CH_3CHO and C_6H_5CHO
   (1) aqueous HCN can be used.
   (2) aqueous KOH can be used.
   (3)  can be used.
   (4)  can be used.
   (5) none of the above can be used.

11. $M^{2+}(aq) + 2e \longrightarrow M(s) \quad E^{\ominus} = -0{\cdot}76\ V$

$X_2(s) + 2e \longrightarrow 2X^-(aq) \quad E^{\ominus} = +1{\cdot}07\ V$

$$M(s) \mid M^{2+}(aq, 1\ mol\ dm^{-3}) \,\|\, X_2(s) \mid X^-(aq, 1\ mol\ dm^{-3})$$

When this electrochemical cell generates electricity,
   (1) $X^-(aq)$ is oxidized.
   (2) $M^{2+}(aq)$ is reduced.
   (3) $M(s)$ bears a negative charge.
   (4) The emf of the cell is – 0·31 V.
   (5) The emf of the cell is + 0·31 V.

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12. Which one of the following statements concerning the C_2H_2 molecule is most appropriate?
(1) In the C_2H_2 molecule there is 1 covalent bond.
(2) In the C_2H_2 molecule there are 2 covalent bonds.
(3) In the C_2H_2 molecule there are 3 covalent bonds.
(4) In the C_2H_2 molecule there are 4 covalent bonds.
(5) In the C_2H_2 molecule there are 5 covalent bonds.

13. Which one of the following statements concerning three of the oxy acids of phosphorus is true?
(1) In the H_3PO_2 molecule there is one P–H bond.
(2) In the H_3PO_2 molecule there are three P–H bonds.
(3) In the H_3PO_4 molecule there is one P–H bond.
(4) In the H_3PO_4 molecule there are three O–H bonds.
(5) In the H_3PO_3 molecule there are three O–H bonds.

14. When KCNS solid was added to a portion of an aqueous solution containing cations of a certain element, a red colour was not obtained. To another portion of the original solution, aqueous ammonia was added and set aside for a short time. The product so obtained was made acidic by adding dilute HCl. When KCNS solid was added to this acidic solution, a red colour was obtained. The cation under consideration could be
(1) Cr^{3+}. (2) Mn^{2+}. (3) Cu^{2+}.
(4) Fe^{2+}. (5) Fe^{3+}.

15. Which one of the following is most likely **not** to react with chlorine?
(1) Ag metal (2) P solid (3) N_2 gas
(4) Ga liquid (5) Aqueous Fe^{2+}

16. Which one of the following statements concerning hot concentrated sulphuric acid is most appropriate?
(1) It reacts with carbon and gives CO_2 and SO_3.
(2) It reacts with carbon and gives CO_2 and SO_2.
(3) It reacts with copper and gives SO_2 and SO_3.
(4) It does not react with copper.
(5) It does not react with carbon.

17. Which pair of the following scientists is **most distantly** connected with the Periodic Table?
(1) Dobereiner and Newlands
(2) Dobereiner and Mendeleeff
(3) Avogadro and Dalton
(4) Mendeleeff and Bohr
(5) Lothar Meyer and Mendeleeff

18. Which one of the following statements concerning the particles used by Geiger and Marsden, in the experiment that provided the basis for the nuclear model of the atom, is most appropriate?
(1) Accelerated particles were used by Geiger and Marsden.
(2) Cathode rays were used by Geiger and Marsden.
(3) Accelerated cathode ray particles were used by Geiger and Marsden.
(4) Accelerated neutrons were used by Geiger and Marsden.
(5) All of the above statements are incorrect.

19. Which one of the following statement concerning ionization energies is true?
(1) The first ionization energy of Al is greater than the first ionization energy of Mg.
(2) The third ionization energy of Mg is greater than the second ionization energy of Al.
(3) The first ionization energy of S is greater than the first ionization energy of P.
(4) The second ionization energy of Na is greater than the third ionization energy of Mg.
(5) None of the above statements is true.

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20. The IUPAC name of $ClCH_2CH_2\overset{Br}{\overset{|}{C}}=CHCOCH_3$ is
(1) 1 – chloro – 3 – bromo – 4 – hexen – 2 – one.
(2) 3 – bromo – 1 – chloro – 3 – hexen – 5 – one.
(3) 4 – bromo – 6 – chloro – 3 – hexen – 2 – one.
(4) 5 – chloromethyl – 4 – bromo – 3 – penten – 2 – one.
(5) 4 – bromo – 5 – chloromethyl – 3 – penten – 2 – one.

21. $C_2O_4^{2-}$ ions are oxidized by MnO_4^- ions in neutral medium. In this reaction the mole ratio, MnO_4^- : $C_2O_4^{2-}$ is
(1) 2 : 5. (2) 5 : 2. (3) 3 : 2. (4) 2 : 3.
(5) none of the above.

22. The straight-chain organic compound of molecular formula C_3Cl_5Br
(1) exists as 3 isomers.
(2) exists as 4 isomers.
(3) exists as 5 isomers.
(4) exists as 6 isomers.
(5) exists as 7 isomers.

23. The gaseous compound, **X** contains boron and hydrogen only. Under $1{\cdot}013 \times 10^5 Nm^{-2}$ pressure and at 276 K, the volume of 1·00 g of the compound **X**, was 0·82 dm^3. The relative atomic masses of boron and hydrogen are respectively, 10·82 and 1·00. Which one of the following could be **X**?
(1) BH_3 (2) B_2H_6 (3) B_2H_2 (4) B_3H_8 (5) B_3H_6

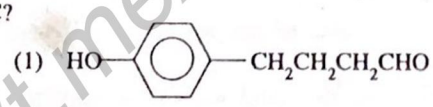
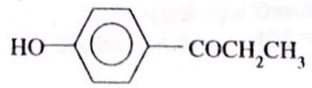
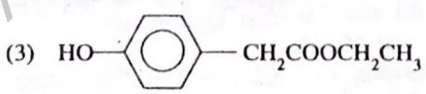
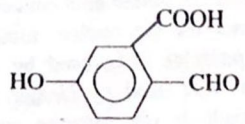
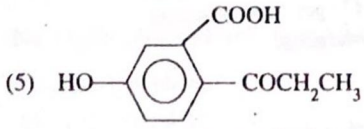
24. Consider the equilibrium,

$$A_2(g) + 2B_2(g) \rightleftharpoons A_2B_4(g).$$

the units of K_C for this reaction are
(1) $mol^3\ dm^{-9}$ (2) $mol^{-3}\ dm^9$. (3) $mol^2\ dm^{-6}$. (4) $mol^{-2}\ dm^6$. (5) $mol^{-2}\ dm^{-6}$.

25. Which one of the following statement is **false**?
(1) I_2 can act as an oxidizing agent.
(2) I_2 can act as a reducing agent.
(3) HI can act as an oxidizing agent.
(4) The iodine in HI can be subjected to reduction by NaH.
(5) The iodine in HOI can be subjected to oxidation.

26. The organic compound, **C** dissolves in aqueous NaOH. However, it does not dissolve in aqueous $NaHCO_3$. **C** gives a precipitate with Brady's reagent. When 1 mol of the product obtained by the reaction of **C** with HCN is heated, 1 mol of water is eliminated very easily. Which one of the following is most likely to be **C**?

(1) 
(2) 
(3) 
(4) 
(5) 

27. The inorganic compound, **D**, when treated with dilute H_2SO_4 gave a brown gas and a coloured solution. When an excess of ammonia was added to a portion of this solution, a blue solution was obtained. When H_2S gas was passed into another portion of the original coloured solution, a black precipitate was **not** obtained. Which one of the following is most likely to be **D**?
(1) $Cu(NO_3)_2$ (2) $Cu(NO_2)_2$ (3) $Cd(NO_2)_2$ (4) $Ni(NO_3)_2$ (5) $Ni(NO_2)_2$

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28. The molecules, $(CH_3)_3P$ and $AlCl_3$ form a coordination compound in the mole ratio of 1 : 1. In this compound, the bond between the P atom and the Al atom
(1) can be shown as $P=Al$.
(2) can be shown as $\overset{+}{P}=\overset{-}{A}l$.
(3) can be shown as $\overset{-}{P}=\overset{+}{A}l$.
(4) can be shown as $P \leftarrow Al$.
(5) can be shown as $P \rightarrow Al$.

29. For the purpose of obtaining a rough idea of the lattice energy of the hypothetical ionic compound, '$NaCl_2$',
(1) the first ionization energy of sodium is essential.
(2) the second ionization energy of sodium is essential.
(3) the standard enthalpy change of the process, $Cl_2(g) + e \longrightarrow Cl_2^-(g)$ is essential.
(4) the standard enthalpy change of the process, $Cl(g) + 2e \longrightarrow Cl^{2-}(g)$ is essential.
(5) none of the above is essential.

30. At constant temperature, the pH of an aqueous solution changed from 8 to 6 as a result of a certain change being effected. Which one of the following statements is most appropriate in this instance?
(1) This change has occurred because $[H^+]$ was increased two-fold.
(2) This change has occurred because $[H^+]$ was increased ten-fold.
(3) This change has occurred because $[H^+]$ was increased hundred-fold.
(4) This change has occurred because $[OH^-]$ was increased hundred-fold.
(5) A definite answer cannot be given in this instance because the exact temperature is not specified.

Instructions for questions No. 31 to 40

For each of the questions **31** to **40** four responses (*a*), (*b*), (*c*), (*d*) are given. One or more of these is/are correct. Select the correct response/responses. Mark (X) against,

(1) if only (*a*) and (*b*) are correct.
(2) if only (*b*) and (*c*) are correct.
(3) if only (*c*) and (*d*) are correct.
(4) if only (*d*) and (*a*) are correct.
(5) if only one response or any other number of responses are correct.

Summary of Instructions				
(1)	(2)	(3)	(4)	(5)
Only (*a*) and (*b*) correct	Only (*b*) and (*c*) correct	Only (*c*) and (*d*) correct	Only (*d*) and (*a*) correct	Only one response or any other number of responses correct

31. Which of the following will react with C_6H_5COCl?
(*a*) $C_6H_5CONH_2$ (*b*) $(CH_3)_3CNH_2$ (*c*) C_6H_5OH (*d*) CHF_3

32. Which of the following concerning K_P and K_C of an equilibrium reaction are/is true?
(*a*) $K_P = K_C(RT)^{\Delta n}$
(*b*) $K_C = K_P(RT)^{\Delta n}$
(*c*) K_P depends on the total pressure of the system.
(*d*) K_C depends on the temperature of the system.

33. Which of the following are/is true?
(*a*) F_2 + hot concentrated KOH $\longrightarrow$ KFO_3 + other products
(*b*) Ag(*s*) + aqueous $Cu(NO_3)_2$ $\longrightarrow$ Cu(*s*) + other products
(*c*) $NH_3 + Br_2 \longrightarrow N_2$ + other products
(*d*) $PICl_2 + H_2O \longrightarrow HI$ + other products

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34. Which of the following statements/statement concerning environmental pollution are/is true?
(*a*) CO_2 is an important factor.
(*b*) NO_2 is an important factor.
(*c*) Urea is an important factor.
(*d*) Super phosphate is an important factor.

35. Which of the following concerning the Avogadro constant L are/is true?
(*a*) The numerical value of L = $\frac{96490\ C}{\text{charge on the } ClO_4^- \text{ ion}}$
(*b*) The numerical value of L = $\frac{192980\ C}{\text{charge on the } Mg^{2+} \text{ ion}}$
(*c*) The numerical value of L = $\frac{289470\ C}{\text{charge on the } NO_3^- \text{ ion}}$
(*d*) The value of L = $\frac{385960\ C}{\text{charge on the } BF_4^- \text{ ion}}$

36. Which of the following statements / statement concerning hydrogen bonds are / is true?
(*a*) Hydrogen bonds occur in $CH_3CH_2NH_2$.
(*b*) Hydrogen bonds occur in $CH_3SiH_2OCH_3$.
(*c*) Hydrogen bonds occur in $CH_3CH_2OSiCH_3$.
(*d*) Hydrogen bonds occur in liquid NH_3.

37. Which of the following statements/statement concerning proteins are/is true?
(*a*) The repeating unit occurring in protein chains is $NH_2—\underset{\displaystyle R}{\underset{|}{C}}HCOOH$.
(*b*) The repeating unit occurring in protein chains is $NH_2—\underset{\displaystyle R}{\underset{|}{C}}HCH_2COOH$.
(*c*) Sulphur may occur in protein chains.
(*d*) Hydrogen bonds may occur in protein chains.

38. Which of the following contribute/contributes very considerably to acid rain?
(*a*) The use of the Contact Process.
(*b*) The oxidation of ammonia by catalysts.
(*c*) The use of the Haber Process.
(*d*) The use of the Ammonia–Soda Process.

39. Originally, the chemists used the term, **'atomic weight'** in place of the modern term, **'relative atomic mass'**. In the determination of the **'atomic weight'** of gaseous elements,
(*a*) Charles's studies were useful.
(*b*) Mendeleeff's studies were useful.
(*c*) Rutherford's studies were useful.
(*d*) Avogadro's studies were useful.

40. Cathode ray particles
(*a*) are negatively charged.
(*b*) travel in straight lines.
(*c*) are attracted towards the N - magnetic pole.
(*d*) are attracted towards the S – magnetic pole.

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Instructions for questions No. 41 to 50

In questions No. **41** to **50**, two statements are given in respect of each question. From the Table given below, select the description (1), (2), (3), (4), (5) that **best** fits the two statements given for each of the questions and mark appropriately.

First Statement	Second Statement
(1) True	True, and correctly explains the first statement.
(2) True	True, but does **not** explain the first statement correctly .
(3) True	False
(4) False	True
(5) False	False

	First Statement	Second Statement
41. (Inorg)	CuS dissolves in hot dilute HNO_3.	In the presence of hot dilute HNO_3, the K_{sp} of CuS increases.
42. (Ionic)	An aqueous solution of Na_2HPO_4 does not exhibit buffer action.	Na_2HPO_4 is not a salt derived from a weak base.
43. (Organic)	The electron pair on the N atom of the CN^- anion attacks the C atom of the $\rangle C{=}O$ group in the CH_3COCH_3 molecule.	The following electron transition may occur in the carbonyl group: 
44. (Organic)	CF_3COOH acts as a strong acid.	The electron pair forming the bond in C—F is attracted towards the F atom.
45. (Inorganic)	Nitrogen cannot act as an oxidizing agent.	The nitrogen atom is incapable of acquiring electrons from outside.
46. (Organic)	Aniline is more basic than $C_6H_5CONHCH_3$.	The $-CH_3$ group repels electrons.
47. (Ionic)	Methyl red is a suitable indicator for the titration between 0·1 mol dm^{-3} aqueous NH_3 and 0·1 mol dm^{-3} aqueous H_2SO_4.	Methyl red indicator is yellow in alkaline medium, while it is red in acidic medium.
48. (General)	H_2O_2 molecule is planar.	In the H_2O_2 molecule, the O—O bond and the two O—H bonds are in the same plane.
49. (Organic)	The $-NHCH_3$, group linked to the benzene is ortho-para directing.	The N atom of the $-NHCH_3$ has a lone pair of electrons, and it increases the electron density in the benzene ring.
50. (Inorganic)	Lime water cannot be used to distinguish between NH_4Cl and $(NH_4)_2SO_4$.	Both NH_4Cl and $(NH_4)_2SO_4$ give ammonia with lime water.

51. Which type of the following equations will most appropriately represent the behaviour of CO_2 gas? (Gas Laws)

(1) $(P + x)(V - y) = nRT$ (2) $PV = nRT$ (3) $M = \frac{d}{P} \times RT$

(4) $\left(P + \frac{na}{V}\right)(V - n^2b) = nRT$ (5) $\left(P + \frac{n^2a}{V}\right)\left(V - \frac{b}{n}\right) = nRT$

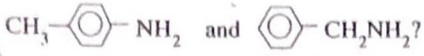
52. For the purpose of converting the compound, $(CH_3CH_2)_2CHOH$ into $(CH_3CH_2)_2C{=}O$ (Organic)

(1) Tollen's reagent can be used. (2) an aqueous solution of K_2CrO_4 can be used.
(3) bromine liquid can be used. (4) chlorine water can be used.
(5) none of the above can be used.

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53. With which of the following pairs of compounds can you start and proceed to distinguish chemically between

 and ?

(1) C_6H_5COCl and anhydrous $AlCl_3$ (2) CH_3I and water
(3) NaOH and HNO_3 (4) NH_3 and HNO_3
(5) H_2SO_4 and NaOH

54. It has become necessary to synthesize $C_6H_5CH_2COOH$ starting from $C_6H_5CONH_2$. Which of the following initial steps is most appropriate for this synthesis?

(1) $C_6H_5CONH_2 + HCHO + AlCl_3$
(2) $C_6H_5CONH_2 + KMnO_4 + NaOH$
(3) $C_6H_5CONH_2 + CH_3MgBr + HCl$
(4) $C_6H_5CONH_2 + Na + CH_3CH_2OH$
(5) $C_6H_5CONH_2 + CH_3CHO$ + anhydrous $AlCl_3$

55. Which one of the following sets of values pertaining to the oxidation numbers exhibited by oxygen is most appropriate?

(1) –2, –1, 0, +2 and +3 (2) –2, –1, and +2
(3) –2, –1, 0 and +2 (4) –2, –1 and 0
(5) –2, 0 and +2

56. Which one of the following statements pertaining to atomic spectra is **false**?

(1) Atomic spectra can be studied as emission spectra.
(2) Atomic spectra can be studied as absorption spectra.
(3) The spectral lines of an atomic spectrum occur as several clearly distinguishable series of lines.
(4) The dark lines of an absorption spectrum do not occur as several clearly distinguishable series of lines.
(5) There is no direct relationship between a given bright line of an atomic spectrum and a certain energy level in the atom under consideration.

57. Which one of the following concerning Raoults' law is most appropriate?

(1) $\frac{P_A - P_A^0}{P_A^0} = x_B$ (2) $\frac{P_A^0 - P_A}{P_A^0} = x_A$

(3) $\frac{P_A^0 - P_A}{P_A} = x_B$ (4) $\frac{P_A^0 - P_A}{P_A} = x_A$

(5) None of the above is in agreement with Raoult's law.

58. Which of the following statements concerning the intermolecular forces in a certain binary system is true?

(1) The forces among CH_3COCH_3 molecules are equal to the forces among CH_3OH molecules.
(2) The forces among CH_3COCH_3 molecules are larger than the forces among CH_3OH molecules.
(3) There are no attractive forces among CH_3COCH_3 molecules.
(4) The CH_3COCH_3—CH_3OH intermolecular forces are smaller than the CH_3OH—CH_3OH intermolecular forces.
(5) The CH_3COCH_3—CH_3OH intermolecular forces are larger than the CH_3COCH_3—CH_3COCH_3 intermolecular forces.

59. Which one of the following statements concerning a catalyst is most appropriate?

(1) A catalyst decreases the activation energy of a reaction.
(2) A catalyst increases the activation energy of a reaction.
(3) A catalyst changes the activation energy of a reaction.
(4) A catalyst decreases the standard enthalpy of formation of products.
(5) A catalyst changes the enthalpy of formation of reactants.

60. The mole fraction of ethanol in an aqueous solution of ethanol is 0·10. What is the ethanol concentration of this solution, **by weight**? (H = 1 ; O = 16 ; C = 12)

(1) 11% (2) 11·06% (3) 20% (4) 22·12% (5) 33·21%

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