UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2003/2004

February/March 2004

# ZCT 104E/3 - Physics IV (Modern Physics)
## *[Fizik IV (Fizik Moden)]*

Duration: 3 hours
*[Masa: 3 jam]*

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Please check that the examination paper consists of **SIXTEEN** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **ENAM BELAS** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

**Instruction**: Answer all **FOUR (4)** questions. Students are allowed to answer all questions in Bahasa Malaysia or in English.

*[**Arahan**: Jawab kesemua **EMPAT** soalan. Pelajar dibenarkan menjawab semua soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

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**Data**

speed of light in free space, $c = 3.00 \times 10^{8}$ m s$^{-1}$

permeability of free space, $\mu_0 = 4\pi \times 10^{-7}$ H m$^{-1}$

permittivity of free space, $\varepsilon_0 = 8.85 \times 10^{-12}$ F m$^{-1}$

elementary charge, $e = 1.60 \times 10^{-19}$ C

the Planck constant, $h = 6.63 \times 10^{-34}$ J s

unified atomic mass constant, $u = 1.66 \times 10^{-27}$ kg

rest mass of electron, $m_e = 9.11 \times 10^{-31}$ kg

rest mass of proton, $m_p = 1.67 \times 10^{-27}$ kg

molar gas constant, = 8.31 J K$^{-1}$ mol$^{-1}$

the Avogadro constant, $N_A = 6.02 \times 10^{23}$ mol$^{-1}$

gravitational constant, $G = 6.67$ x 10-11 N m$^2$ kg$^{-2}$

acceleration of free fall, $g = 9.81$ m s$^{-2}$

**Question 1. (25 marks)**

1.1 A spaceship of proper length $L_p$ takes $t$ seconds to pass an Earth observer. What is its speed as measured by the Earth observer according to classical physics?
*[Sebuah kapal angkasa yang panjang proper-nya $L_p$ mengambil masa $t$ untuk bergerak melalui seorang pemerhati di Bumi. Mengikut fizik klasik, apakah kelajuannya yang terukur oleh pemerhati di Bumi itu?]*

**A.** $L_P / t$ **B.** $\dfrac{cL_P / t}{\sqrt{c^2 + (L_P / t)^2}}$ **C.** $c$ **D.** $L_P$

**E.** Non of the above
*[Tiada dalam pilihan di atas]*

1.2 In Question 1, what is its speed as measured by the Earth observer according to special relativity?
*[Dalam soalan* 1*, apakah kelajuan yang terukur oleh pemerhati di Bumi mengikut teori kerelatifan khas?]*

**A.** $L_P / t$ **B.** $\dfrac{cL_P / t}{\sqrt{c^2 + (L_P / t)^2}}$ **C.** $c$ **D.** $L_P$

**E.** Non of the above
*[Tiada dalam pilihan di atas]*

1.3 What is the momentum of a proton if its total energy is twice its rest energy?
*[Apakah momentum bagi suatu proton jika jumlah tenaganya adalah dua kali tenaga rehatnya?]*

**A.** 1620 Ns **B.** 1 MeV/$c$ **C.** 938 MeV/$c$ **D.** 2 MeV/$c$

**E.** 1620 MeV/$c$

1.4 The power output of the Sun is $3.8\times10^{26}$ W. How much rest mass is converted to kinetic energy in the Sun each second?
*[Output kuasa Matahari ialah* $3.8\times10^{26}$ W*. Berapakah jisim rehat yang ditukarkan kepada tenaga kinetik setiap saat di dalam Matahari?]*

**A.** $4.2\times10^{9}$ kg **B.** $1.3\times10^{17}$ kg **C.** $3.6\times10^{8}$ kg

**D.** $6.6\times10^{10}$ kg **E.** $4.2\times10^{8}$ kg

1.5 What is the value of $hc/e$ in unit of nm · eV
*[Apakah nilai hc/e dalam unit* nm · eV *?]*

**A.** 1.240 **B.** $1240\times10^{-6}$ **C.** 1240 **D.** $1240\times10^{-9}$

**E.** $1240\times10^{-3}$

1.6 By what factor is the mass of an electron accelerated to the speed of 0.999*c* larger than its rest mass?
*[Berapa besarnya factor jisim satu elektron yang dipecutkan kepada kelajuan* 0.999c *berbanding dengan jisim rehatnya?]*

**A.** 31.6 **B.** 0.03 **C.** 0.04 **D.** 22.3 **E.** 1.0

1.7 The rest mass of a photon
*[Jisim rehat foton]*

**A.** is zero
*[ialah sifar]*
**B.** is the same as that of an electron
*[sama dengan jisim elektron]*
**C.** depends on its frequency
*[bergantung kepada frekuensinya]*
**D.** depends on its energy
*[bergantung kepada tenaganya]*
**E.** Non of the above
*[Tiada dalam pilihan di atas]*

1.8 Determine the vacuum wavelength corresponding to a $\gamma$-ray energy of $10^{19}$ eV
*[Tentukan jarak gelombang vakum bagi sinar* $\gamma$ *yang bersepadanan dengan tenaga* $10^{19}$ eV ]

**A.** $1.24\times10^{-9}$ pm
**B.** $1.24\times10^{-16}$ pm
**C.** $1.24\times10^{-25}$ nm
**D.** $1.24\times10^{-16}$ nm
**E.** $1.24\times10^{-25}$ nm

1.9 To produce an x-ray quantum energy of $10^{-15}$ J electrons must be accelerated through a potential difference of about
*[Untuk menghasilkan sinar-x dengan tenaga kuantum $10^{-15}$ J suatu elektron mesti dipecutkan melalui satu beza keupayaan yang nilainya lebih kurang]*

**A.** 4 kV
**B.** 6 kV
**C.** 8 kV
**D.** 9 kV
**E.** 10 kV

**Question 1.10– 1.12**
***[Soalan 1.10-1.12]***

**A.** $10^{-4}$ m
**B.** $10^{-7}$ m
**C.** $10^{-10}$ m
**D.** $10^{-12}$ m
**E.** $10^{-15}$ m

1.10 Which of the values in the list above is the best estimate of the radius of an atom?
*[Nilai yang manakah dalam senarai di atas memberikan anggaran yang paling baik untuk radius satu atom?]*

1.11 Which of the values in the list above is the best estimate of the wavelength of visible light?
*[Nilai yang manakan dalam senarai di atas memberikan anggaran yang paling baik untuk jarak gelombang cahaya ternampak?]*

1.12 Which of the values in the list above is the best estimate of the wavelength of a 1.5 MeV electron?
*[Nilai yang manakan dalam senarai di atas memberikan anggaran yang paling baik untuk jarak gelombang bagi elektron* 1.5 MeV*?]*

1.13 What is the momentum of a single photon of red light ($\nu = 400 \times 10^{12}$ Hz) moving through free space?
*[Apakah momentum foton cahaya merah ($\nu = 400 \times 10^{12}$ Hz) yang bergerak melalui ruang bebas?]*

**A.** $8.8 \times 10^{-27}$ kg m/s
**B.** 6 keV
**C.** 1240 eV/$c$
**D.** 1.65 eV/$c$
**E.** 2.4 eV/$c$

1.14 What potential difference must be applied to stop the fastest photoelectrons emitted by a nickel surface under the action of ultraviolet light of wavelength 2000 Å? The work function of nickel is 5.00 eV.
*[Apakah beza keupayaan yang mesti dikenakan untuk menghentikan fotoelektron paling pantas yang dipancarkan dari permukaan nikel di bawah tindakan cahaya ultraungu yang jarak gelombangnya* 2000 Å*? Fungsi kerja nikel ialah* 5.00 eV.*]*

**A.** 1.0 kV
**B.** 1.2 kV
**C.** 2.0 V
**D.** 1.0 V
**E.** 1.2 V

1.15 Which of the following statement(s) is (are) true?
*[Manakah kenyataan yang berikut adalah benar?]*

**I.** The assumption of the Ether frame is inconsistent with the experimental observation
*[Tanggapan rangka Ether adalah tidak konsisten dengan pemerhatian eksperimen]*

**II.** The speed of light is constant
*[Kelajuan cahaya adalah malar]*

**III.** Maxwell theory of electromagnetic radiation is inconsistent with the notion of the Ether frame
*[Teori sinaran keelektromagnetan Maxwell adalah tidak konsisten dengan tanggapan rangka Ether]*

**IV** Special relativity is inconsistent with the notion of the Ether frame
*[Kerelatifan Khas adalah tidak konsistent dengan tanggapan rangka Ether]*

**A.** III,IV **B.** I, II, III **C.** I, II, III,IV

**D.** I, II **E.** I, II,IV

1.16 Which of the following statements are true about light?
*[Yang manakah kenyataan berikut adalah benar berkenaan dengan cahaya?]*

**I.** It propagates at the speed of $c = 3 \times 10^8$ m/s in all medium
*[Cahaya tersebar pada kelajuan* c = 3 x $10^8$ m/s *dalam semua jenis medium]*

**II.** It's an electromagnetic wave according to the Maxwell theory
*[Cahaya ialah gelombang elektromagnetik mengikut teori Maxwell]*

**III.** It's a photon according to Einstein
*[Cahaya ialah foton menurut Einstein]*

**IV.** It always manifests both characteristics of wave and particle simultaneously in a given experiment
*[Cahaya sentiasa memperlihatkan kedua-dua ciri gelombang dan kezarahan secara serentak dalam sesuatu eksperimen]*

**A.** I,IV **B.** II, III,IV **C.** I, II, III,IV

**D.** I, II **E.** II,III

1.17 Which of the following statements are true about Lorentz transformation?
*[Yang manakah kenyataan berikut adalah benar berkenaan dengan transformasi Lorentz?]*

**I.** It relates the space-time coordinates of one inertial frame to the other
*[Ia menghubung-kaitkan koordinat-koordinat ruang-masa suatu rangka inersia dengan koordinat-koordinat ruang-masa rangka inersia lain]*

**II.** It is the generalisation of Galilean transformation
*[Ia merupakan generalisasi transformasi Galilean]*

**III.** It constitutes one of the Einstein's special relativity postulates
*[Ia merupakan salah satu postulat teori kerelatifan khas Einstein]*

**IV.** Its derivation is based on the constancy of the speed of light postulate
*[Ia diterbitkan berdasarkan postulat kemalaran kelajuan cahaya]*

**A.** I,IV **B.** I,II, IV **C.** I, II, III,IV

**D.** I, II **E.** II,III

1.18 The expression of linear momentum has to be modified in the relativistic limit in order to
*[Ekspresi momentum linear kena dimodifikasikan pada limit relativistik supaya]*

**I.** preserve the consistency between the Lorentz transformation and conservation of linear momentum
*[konsistensi antara transformasi Lorentz dengan keabadian momentum linear terpelihara]*

**II.** preserve the consistency between the Galilean transformation and conservation of linear momentum
*[konsistensi antara transformasi Galilean dengan keabadian momentum linear terpelihara]*

**III.** preserve the consistency between special relativity with Newtonian mechanics
*[konsistensi antara kerelatifan khas dengan mekanik Newton terpelihara]*

**IV.** preserve the consistency between the Lorentz transformation and Galilean transformation
*[konsistensi antara transformasi Lorentz dengan transformasi Galilean terpelihara]*

**A.** I only **B.** I,II, IV **C.** I, III,IV **D.** III,IV **E.** IV only

**Question 2. (25 marks)**
***[Soalan 2 (25 markah)]***

2.1 What is the kinetic energy of the fastest photoelectrons emitted by a copper surface, of work function 4.4 eV when illuminated by visible light 0f 700 nm?
*[Apakah tenaga kinetik fotoelektron paling pantas yang dipancarkan oleh permukaan kuprum, yang fungsi kerjanya* 4.4 eV, *semasa disinari cahaya ternampak* 700 nm*?]*

**A.** 1.17 eV
**B.** 6.17 eV
**C.** 1.17 eV
**D.** 1.0 eV
**E.** non of the above
*[Tiada dalam pilihan di atas]*

2.2 Suppose that a beam of 0.2-MeV photon is scattered by the electrons in a carbon target. What is the wavelength of those photon scattered through an angle of 90°?
*[Katakan satu bim foton* 0.2 MeV *diserakkan oleh elektron di dalam sasaran karbon. Apakah jarak gelombang bagi foton yang diserakkan melalui satu sudut* 90°*?]*

**A.** 0.00620 nm
**B.** 0.00863 nm
**C.** 0.01106 nm
**D.** 0.00243 nm
**E.** non of the above
*[Tiada dalam pilihan di atas]*

2.3 Determine the cut-off wavelength of x-rays produced by 50-keV electrons in a x-ray vacuum tube?
*[Tentukan jarak gelombang penggal bagi sinar-x yang dihasilkan oleh elektron* 50 keV *dalam satu tiub sinar-x vakum.]*

**A.** 0.000248 $\mathring{A}$
**B.** 2.48 $\mathring{A}$
**C.** 248 $\mathring{A}$
**D.** 0.248 $\mathring{A}$
**E.** non of the above
*[Tiada dalam pilihan di atas]*

2.4 A lamp emits light of frequency $5.0\times10^{15}$ Hz at a power of 25 W. The number of photons given off per seconds is
*[Suatu lampu memancarkan cahaya berfrekuensi* $5.0\times10^{15}$ Hz *pada kuasa* 25 W. *Bilangan foton yang dihasilkan per saat ialah]*

**A.** $1.3\times10^{-19}$ **B.** $8.3\times10^{-17}$ **C.** $7.5\times10^{18}$ **D.** $1.9\times10^{50}$
**E.** $2.9\times10^{13}$

2.5 Which of the following transitions in a hydrogen atom emits the photon of lowest frequency?
*[Dalam senarai di bawah, peralihan yang manakah memancarkan foton frekuensi terendah di dalam atom hidrogen?]*

**A.** $n = 1$ to $n = 2$ **B.** $n = 2$ to $n = 1$ **C.** $n = 2$ to $n = 6$

**D.** $n = 6$ to $n = 2$ **E.** $n$ = infinitely large to $n = 1$
*[n = sebesar tak terhingga ke n = 1]*

2.6 The speed of an electron whose de Broglie wavelength is $1.0 \times 10^{-10}$ m is
*[Kelajuan satu elektron yang jarak gelombang de Broglie-nya* $1.0 \times 10^{-10}$ m *ialah ]*

**A.** $6.6 \times 10^{-24}$ m/s **B.** $3.8 \times 10^{3}$ m/s **C.** $7.3 \times 10^{6}$ m/s

**D.** $1.0 \times 10^{10}$ m/s **E.** $6.6 \times 10^{2}$ m/s

2.7 A large value of the probability density of an atomic electron at a certain place and time signifies that the electron
*[Nilai yang besar bagi ketumpatan kebarangkalian suatu elektron atom pada sesuatu tempat dan masa menunjukkan elektron itu]*

**A.** is likely to be found there
*[agak mungkin dijumpai di sana]*

**B.** is certain to be found there
*[pasti dijumpai di sana]*

**C.** has a great deal of energy there
*[mempunyai banyak tenaga di sana]*

**D.** has a great deal of charge
*[mempunyai banyak cas]*

**E.** is unlikely to be found there
*[tidak berapa mungkin dijumpai di sana]*

2.8 Ionisation energy of hydrogen is 13.5 eV. What is the shortest wavelength in the Lyman series of hydrogen atom?
*[Tenaga pengionan hidrogen ialah* 13.5 eV. *Apakah jarak gelombang terpendek dalam siri Lyman hidrogen?]*

**A.** 364 nm **B.** 121 nm **C.** 91 nm **D.** 819 nm

**E.** 103 nm

2.9 If the momentum of a particle is doubled, its wavelength is multiplied _____ times
*[Jika momentum suatu zarah digandakan dua, jarak gelombangnya digandakan _____ kali]*

**A.** 1 **B.** 2 **C.** 1/2 **D.** 8 **E.** 0

2.10 A standing wave cannot have less than ___ antinode. In quantum mechanics, that fundamental mode would be called the _____.
*[Suatu gelombang pegun tidak boleh mempuyai kurang daripada _____antinod. Dalam mekanik kuantum, mod asas ini dinamakan _____. ]*

**A.** 1, first excited state
*[keadaan teruja pertama]*

**B.** 1, ground state
*[keadaan dasar]*

**C.** 2, first excited state
*[keadaan teruja pertama]*

**D.** 2, ground state
*[keadaan dasar]*

**E.** 0, ground state
*[keadaan dasar]*

2.11 Assume that the uncertainty in the position of a particle is equal to its de Broglie wavelength. What is the minimal uncertainty in its velocity, $v_x$?
*[Anggapkan bahawa ketidakpastian dalam kedudukan suatu zarah adalah sama dengan jarak gelombang de Broglie-nya. Apakah ketidakpastian minimum dalam halajunya* $v_x$*?]*

**A.** $v_x/4\pi$ **B.** $v_x/2\pi$ **C.** $v_x/8\pi$ **D.** $v_x$

**E.** $v_x/\pi$

2.12 If the ionisation energy for a hydrogen atom is 13.6 eV, what is the energy of the level with quantum number $n = 3$?
*[Jika tenaga pengionan satu atom hidrogen ialah* 13.6 eV, *apakah tenaga untuk paras yang bernombor kuantum n = 3?]*

**A.** 1.51 eV **B.** 3.4 eV **C.** 12.1 eV

**D.** -1.51 eV **E.** -3.4 eV

2.13 What is the zero-point energy of an electron trapped in an infinite potential well of size $L = 0.5\ \mathring{A}$
*[Apakah tenaga titik-sifar bagi elektron yang terperangkap di dalam suatu telaga keupayaan infinit yang saiznya $L = 0.5\ \mathring{A}$]*

**A.** $7.5\times10^{-9}$ eV **B.** $11.7\times10^{-6}$ eV **C.** $0.30\times10^{-6}$ eV

**D.** 13.6 eV **E.** $65\times10^{-6}$ eV

2.14 A moving body is described by the wave function $\psi$ at a certain time and place; $\psi^2$ is proportional to the body's
*[Suatu jasad bergerak diperihalkan oleh fungsi gelombang $\psi$ pada suatu masa dan tempat tertentu; $\psi^2$ adalah berkadar dengan]*

**A.** electric field
*[medan elektrik]*
**B.** speed
*[kelajuan]*
**C.** energy
*[tenaga]*
**D.** probability of being found
*[kebarangkalian untuk dijumpai]*
**E.** mass
*[jisim]*

2.15 The continuous x-ray spectrum produced in an x-ray tube can be explained by *[Keselanjaran spektrum sinar-x yang dihasilkan dalam suatu tiub sinar-x dapat diterangkan oleh]*

**I.** Classical Electromagnetic wave theory
*[Teori klasik gelombang keelektromagnetan]*
**II.** Pair production
*[Penghalisan pasangan]*
**III.** Bremsstrahlung
*[Bremsstrahlung]*
**IV.** Diffraction
*[Belauan]*

**A.** I,IV **B.** I,II, IV **C.** I, III,IV **D.** I, III

**E.** II,III

...13/-

2.16 Planck constant
*[Pemalar Planck]*

**I.** is a universal constant
*[ialah satu pemalar universal]*
**II.** is the same for all metals
*[adalah sama bagi semua jenis logam]*
**III.** is different for different metals
*[adalah tidak sama bagi logam yang berlainan]*
**IV.** characterises the quantum scale
*[mencirikan skala kuantum]*

**A.** I,IV **B.** I,II, IV **C.** I, III,IV **D.** I, III

**E.** II,III

2.17 A neon sign produces
*[Suatu lampu neon menghasilkan]*

**I.** a line spectrum
*[suatu spektrum garis]*
**II.** an emission spectrum
*[suatu spektrum pancaran]*
**III.** an absorption spectrum
*[suatu spektrum penyerapan]*
**IV.** photons
*[foton]*

**A.** I,IV **B.** I,II, IV **C.** I, III,IV **D.** I, III

**E.** II,III

2.18 Which of the following statements are true?
*[Kenyataan berikut yang manakah benar?]*

**I.**. the ground states are states with lowest energy
*[keadaan asas adalah keadaan dengan tenaga yang paling rendah]*
**II.** ionisation energy is the energy required to raise an electron from ground state to free state
*[tenaga pengionan adalah tenaga yang diperlukan untuk menaikan suatu elektron dari keadaan asas ke keadaan bebas]*

III. Balmer series is the lines in the spectrum of atomic hydrogen that corresponds to the transitions to the $n = 1$ state from higher energy states
*[Balmer siri adalah garis-garis spectrum atom hidrogen yang bersepadanan dengan peralihan dari paras-paras tenaga yang lebih tinggi ke paras n = 1]*

**A.** I,IV **B.** I,II, IV **C.** I, III,IV **D.** I, II

**E.** II,III

**Question 3. (25 marks)**
*[Soalan 3. (25 markah)]*

(a) Lithium, beryllium and mercury have work functions of 2.3 eV, 3.9 eV and 4.5 eV, respectively. If a 400-nm light is incident on each of these metals, determine
*[Fungsi kerja Lithium, beryllium dan raksa adalah 2.3 eV, 3.9 eV dan 4.5 eV masing-masing. Jika cahaya 400 nm ditujukan ke atas setiap satu logam* itu, tentukan]

(i) which metals exhibit the photoelectric effect, and
*[logam yang manakah memperlihatkan kesan fotoelectrik, dan ]*

(ii) the maximum kinetic energy for the photoelectron in each case (in eV)
*[tenaga kinetik maksimum untuk fotoelektron dalam setiap kes itu (dalam unit eV)]*

(b) Molybdenum has a work function of 4.2 eV.
*[Fungsi kerja Molybdenum ialah 4.2 eV.]*

(i) Find the cut-off wavelength (in nm) and threshold frequency for the photoelectric effect.
*[Carikan jarak gelombang penggal (dalam unit* nm*) dan frekuensi ambang untuk kesan fotoelektrik]*

(ii) Calculate the stopping potential if the incident radiation has a wavelength of 180 nm.
*[Hitungkan keupayaan penghenti jika sinaran tuju mempunyai jarak gelombang 180* nm*.]*

(c) A 0.0016-nm photon scatters from a free electron. For what scattering angle of the photon do the recoiling electron and the scattered photon have the same kinetic energy?
*[Suatu foton 0.0016 nm diserakkan oleh elektron bebas. Apakah sudut serakan foton supaya elektron yang tersentak dan foton yand terserak itu mempunyai tenaga kinetik yang sama?]*

**Question 4. (25 marks)**
***[Soalan 4. (25 markah]***

(a) An electron is contained in a one-dimensional box of width 0.100 nm. Using the particle-in-a-box model,
*[Suatu elektron terkandung di dalam satu kotak satu dimensi yang lebarnya 0.100 nm. Dengan menggunakan model zarah-dalam-satu-kotak]*

(i) Calculate the $n = 1$ energy level and $n = 4$ energy level for the electron in eV.
*[Hitungkan paras tenaga n = 1 dan n = 4 untuk elektron itu dalam unit eV.]*

(ii) Find the wavelength of the photon (in nm) in making transitions that will eventually get it from the the $n = 4$ to $n = 1$ state
*[Hitungkan jarak gelombang foton (dalam unit nm) semasa ia membuat peralihan yang membawanya dari keadaan n = 4 ke keadaan n = 1 ]*

(b) Consider a 20-GeV electron.
*[Pertimbangkan suatu elektron 20 GeV.]*

(i) What is its Lorentz factor $\gamma$?
*[Apakah faktor Lorentznya?]*

(ii) What is its de Broglie wavelength?
*[Apakah jarak gelombang de Broglie-nya?]*

(c) A photon is emitted as a hydrogen atom undergoes a transition from the $n = 6$ state to the $n = 2$ state. Calculate
*[Suatu foton dipancarkan ketika suatu atom hidrogen melakukan satu peralihan dari keadaan n = 6 ke n = 2. Hitungkan]*

(i) the energy
*[tenaga]*
(ii) the wavelength
*[jarak gelombang]*
(iii) the frequency
*[frekuensi]*

of the emitted photon
*[foton yang dipancarkan]*

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**ZCT 104/3E Modern Physics**
**Final Exam**
**Objectives answer sheet**

**Nombor Peperiksaan:**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1.1** | A | B | C | D | E | **2.1** | A | B | C | D | E |
| **1.2** | A | B | C | D | E | **2.2** | A | B | C | D | E |
| **1.3** | A | B | C | D | E | **2.3** | A | B | C | D | E |
| **1.4** | A | B | C | D | E | **2.4** | A | B | C | D | E |
| **1.5** | A | B | C | D | E | **2.5** | A | B | C | D | E |
| **1.6** | A | B | C | D | E | **2.6** | A | B | C | D | E |
| **1.7** | A | B | C | D | E | **2.7** | A | B | C | D | E |
| **1.8** | A | B | C | D | E | **2.8** | A | B | C | D | E |
| **1.9** | A | B | C | D | E | **2.9** | A | B | C | D | E |
| **1.10** | A | B | C | D | E | **2.10** | A | B | C | D | E |
| **1.11** | A | B | C | D | E | **2.11** | A | B | C | D | E |
| **1.12** | A | B | C | D | E | **2.12** | A | B | C | D | E |
| **1.13** | A | B | C | D | E | **2.13** | A | B | C | D | E |
| **1.14** | A | B | C | D | E | **2.14** | A | B | C | D | E |
| **1.15** | A | B | C | D | E | **2.15** | A | B | C | D | E |
| **1.16** | A | B | C | D | E | **2.16** | A | B | C | D | E |
| **1.17** | A | B | C | D | E | **2.17** | A | B | C | D | E |
| **1.18** | A | B | C | D | E | **2.18** | A | B | C | D | E |