本試題是否可以使用計算機：☑可使用 ，□不可使用 （請命題老師勾選）　　考試日期：0301，節次：1

A 卷：普通物理(20 題[1-20], 每題 1.5 分)、物理冶金(20 題[21-40], 每題 1.5 分)、量子物理導論(20 題[41-60], 每題 1.5 分)。滿分 90 分。倒扣至零分為止。

科目名稱： 普通物理

每題為 4 選 1，每一題答對得 1.5 分，答錯倒扣 0.375 分。

1. At what temperature are the numerical values on the Celsius and Fahrenheit scales identical?
   Ⓐ 40^{o}F　Ⓑ 0^{o}F　Ⓒ 0^{o}C　Ⓓ 233K

2. In a constant-volume gas thermometer the pressure is 0.02atm at 100 °C . Estimate: the pressure at the triple point of water.
   Ⓐ 0.0146 atm　Ⓑ 0.146 atm　Ⓒ 1.46 atm　Ⓓ 14.6 atm

3. A rope of length 3m has a mass of 25kg. If the speed of transverse waves is 40m/s, what is the tension in the rope?
   Ⓐ 13.3 kg　Ⓑ 13.3 N　Ⓒ 75 kg　Ⓓ 75 N

4. A rod of length 2.5m and cross-sectional area 0.3cm^2 stretches by 0.1cm when a tension of 800N is applied. What is its Young's modulus?
   Ⓐ 6.67×10^{4} MPa　Ⓑ 6.67×10^{6} MPa　Ⓒ 6.67×10^{8} MPa　Ⓓ 6.67×10^{10} MPa

5. Two point particles, each of mass 100kg , are initially at rest 1m apart in outer space. What are their speeds when their separation is 0.5m?
   Ⓐ 8.17×10^{-1} m/sec　Ⓑ 8.17×10^{-3} m/sec　Ⓒ 8.17×10^{-5} m/sec　Ⓓ 8.17×10^{-7} m/sec

6. A pendulum bob of mass m is released from a height H above the lowest point. It collides at the lowest point with another pendulum of the same length but with a bob of mass 2m initially at rest. Find the heights to which the bobs rise given that the collision is completely inelastic.
   Ⓐ $\frac{1}{3}H$　Ⓑ $\frac{1}{9}H$　Ⓒ $3H$　Ⓓ $9H$

7. The head of a golf club strikes a 46-g golf ball at rest. If the collision lasts 0.5ms and the ball is given a speed of 220km/h, estimate the average force on the ball.
   Ⓐ 2450 N　Ⓑ 5620 N　Ⓒ 9800 N　Ⓓ 50600 N

8. A 10-g bullet traveling at 400m/s strikes a wooden block and emerges at 100m/s. It was in the block for 0.01s. What was the force on the block?
   Ⓐ 100 N　Ⓑ 200 N　Ⓒ 300 N　Ⓓ 500 N

(背面仍有題目,請繼續作答)

9. With one exception, each of the following units can be used to express mass. What is the exception?

Ⓐ newton Ⓑ gram Ⓒ kilogram Ⓓ $N \cdot s^2/m$

10. Complete the following statement: The term *net force* most accurately describes

Ⓐ the mass of an object
Ⓑ the quantity that keeps an object
Ⓒ the inertia of an object
Ⓓ the quantity that changes the velocity of an object

11. A book is resting on the surface of a table. Consider the following four forces that arise in this situation:

(*1*) the force of the earth pulling on the book (*3*) the force of the book pushing on the table
(*2*) the force of the table pushing on the book (*4*) the force of the book pulling on the earth
The book has an acceleration of 0 m/s^2. Which pair of forces, excluding "action-reaction" pairs, must be equal in magnitude and opposite in direction?

Ⓐ *1* and *2* Ⓑ *1* and *4* Ⓒ *2* and *4* Ⓓ *1* and *3*

12. Consider the following forces. *(1)* frictional *(2)* gravitational *(3)* tension *(4)* strong nuclear *(5)* normal *(6)* electroweak

Which of the forces listed are considered fundamental forces?

Ⓐ *1*, *2*, and *4* Ⓑ *1*, *3*, and *5* Ⓒ *2*, *3*, *4*, and *6* Ⓓ *2*, *4*, and *6*

13. Two point masses *m* and *M* are separated by a distance *d*. If the distance between the masses is increased to 3*d*, how does the gravitational force between them change?

Ⓐ The force will be one-third as great.
Ⓑ The force will be one-ninth as great.
Ⓒ The force will be three times as great.
Ⓓ It is impossible to determine without knowing the numerical values of *m*, *M*, and *d*.

14. A baseball is hit upward and travels along a parabolic arc before it strikes the ground. Which one of the following statements is necessarily true?

Ⓐ The acceleration of the ball decreases as the ball moves upward.
Ⓑ The velocity of the ball is zero m/s when the ball is at the highest point in the arc.
Ⓒ The acceleration of the ball is zero m/s^2 when the ball is at the highest point in the arc.
Ⓓ The *x*-component of the velocity of the ball is the same throughout the ball's flight.

15. A physics student standing on the edge of a cliff throws a stone vertically *downward* with an

initial speed of 10.0 m/s. The instant before the stone hits the ground below, it is traveling at a speed of 30.0 m/s. If the physics student were to throw the rock *horizontally outward* from the cliff instead, with the same initial speed of 10.0 m/s, what is the magnitude of the velocity of the stone just before it hits the ground?

Ⓐ 10.0 m/s Ⓑ 40.0 m/s ©20.0 m/s Ⓓ 30.0 m/s

16. The A-string on a string bass is tuned to vibrate at a fundamental frequency of 55.0 Hz. If the tension in the string were increased by a factor of four, what would be the new fundamental frequency?

Ⓐ 220 Hz Ⓑ 110 Hz Ⓒ 55.0 Hz Ⓓ 27.5 Hz

17. Unpolarized light whose intensity is 1.1 W/m^2 is incident on the polarizer. If an analyzer is set at an angle of $\theta = 75°$ with respect to the polarizer, what is the intensity of the light that leaving the analyzer?

Ⓐ 0.037 W/m^2 Ⓑ 0.035 W/m^2 Ⓒ 0.55 W/m^2 Ⓓ 0.92 W/m^2

18. Two small objects, A and B, are fixed in place and separated by 2.00 cm. Object A has a charge of +1.00 μC, and object B has a charge of -1.00 μC. How many electrons must be removed from A and put onto B to make the electrostatic force that acts on each object an attractive force whose magnitude is 45.0 N?

Ⓐ 2.6×10^{11} Ⓑ 2.6×10^{12} Ⓒ 2.6×10^{13} Ⓓ 2.6×10^{14}

19. A rectangle has a length of 2d and a height of d. Each of the following three charges is located at a corner of the rectangle: $+q_1$ (upper left corner), $+q_2$ (lower right corner), and $-q$ (lower left corner). The net electric field at the (empty) upper right corner is zero. Find the magnitude of q_1 and q_2.

Ⓐ $q_1 = 0.895\ q$; $q_2 = 0.0716\ q$ Ⓑ $q_1 = 0.0716\ q$; $q_2 = 0.895\ q$
Ⓒ $q_1 = 0.0895\ q$; $q_2 = 0.716\ q$ Ⓓ $q_1 = 0.716\ q$; $q_2 = 0.0895\ q$

20. One day, the electric field in the atmosphere near ground level is 110 N/C. Assume that the magnitude of this field is the same everywhere around the earth and that the direction of the field is radially inward. The radius of the earth is 6.38×10^6 m. Calculate the net electric charge (magnitude and sign) on the earth.

Ⓐ -2.5×10^5 C Ⓑ $+2.5\times10^5$ C Ⓒ -5.0×10^5 C Ⓓ $+5.0\times10^5$ C

(背面仍有題目,請繼續作答)

科目名稱： 物理冶金

每題為 4 選 1，每一題答對得 1.5 分，答錯倒扣 0.375 分。

21. Taking one mole atoms of Na and Cl and indicating which states would possess the highest energy.
Ⓐ $Na^+_{(g)}+Cl^-_{(g)}$ Ⓑ $Na_{(g)}+Cl_{(g)}$ Ⓒ $Na^+Cl^-_{(g)}$ Ⓓ $Na^+Cl^-_{(s)}$

22. The Madelung energy is
Ⓐ The bond energy of the crystal
Ⓑ The lattice energy of an ionic crystal
Ⓒ The electrostatic energy of an ionic crystal
Ⓓ The internal energy of the crystal.

23. The lattice energy of an ionic solid is
Ⓐ The sum of electrostatic and repulsive energies
Ⓑ The minimum of electrostatic and repulsive energies
Ⓒ The difference between electrostatic and repulsive energies
Ⓓ The product of electrostatic and repulsive energies

24. The wurtizite structure of zinc sulphide has the sulphur atoms in a hexagonal close-packed array and the zinc atoms occupying half the tetrahedral positions; the formula of the sulphide is
Ⓐ Zn_2S Ⓑ ZnS Ⓒ ZnS_2 Ⓓ Zn_3S

25. Clays are silicate containing
Ⓐ Chains of $[SiO_4]$ plus hydroxyl Ⓑ Networks of $[SiO_4]$ plus hydroxyl
Ⓒ Sheets of $[SiO_4]$ plus hydroxyl Ⓓ Chains of $[SiO_3]$ plus hydroxyl

26. Self-diffusion is diffusion of
Ⓐ Radioactive atoms in a crystal Ⓑ Impurity atoms in a crystal
Ⓒ Native atoms in a crystal Ⓓ Vacancies in a crystal

27. A redox reaction is one in which:
Ⓐ Oxidation and reduction occurs Ⓑ Oxidation or reduction occurs
Ⓒ Oxygen takes part Ⓓ Oxygen loss

28. During plastic deformation, dislocations move preferentially on:

Ⓐ Slip planes Ⓑ Twin planes Ⓒ Slip direction Ⓓ Any planes

29. On deformation of a FCC crystal, the primary and conjugated slip systems are (111)[1,0,-1] and (1,-1,-1)[110], respectively, then the stress axis eventually lies on the
Ⓐ (1,-1,1) Ⓑ (112) Ⓒ (1,-1,2) Ⓓ (1,1,-2)
plane.

30. On deformation of a FCC crystal, the primary system is (111)[1,0,-1], then the double cross-slip systems can be
Ⓐ (1,-1,-1)[1,0,-1] Ⓑ (1,-1,1)[-1,0,1] Ⓒ (1,-1,1)[1,1,0] Ⓓ (1,-1,1)[1,0,-1].

31. An array of etch pits reveals the movement of a dislocation; therefore, among them the etch pit with the
Ⓐ largest Ⓑ middle Ⓒ smallest Ⓓ unchanged
size reveals the original position of this dislocation.

32. For a triclinic crystal with lattice constants, a = 3i, b = 2j, c = 1k, the reciprocal lattice vector, G_{222}, is
Ⓐ [b×c, c×a, a×b] Ⓑ 1/2[b×c, c×a, a×b]
Ⓒ 1/3[b×c, c×a, a×b] Ⓓ 1/6[b×c, c×a, a×b]

33. Upon thermal evaporation of oxide powders, oxide nanowires can be grown without a metal catalyst. In addition, no spheroid appears on the tops of nanowires. This result reveals that the growth likely follows the
Ⓐ vapor-solid Ⓑ liquid-solid
Ⓒ solid-liquid-solid Ⓓ vapor-liquid-solid
mechanism.

34. In order to precisely analyze the mismatch between the lattice planes of the epitaxial film and the substrate, the
Ⓐ traditional x-ray diffraction Ⓑ grazing incident x-ray diffraction
Ⓒ total external reflection diffraction Ⓓ double crystal diffractometer
can be used

35. To define a crystallographic direction, conversion from the three-index system [u' v' w'] to the four-index system (Miller-Bravais) [u v t w] can be accomplished by
Ⓐ $u = n(2u' - v')/3$ Ⓑ $u = n(u' - 2v')/2$
Ⓒ $u = n(v' - 2u')/3$ Ⓓ $u = n(2v' - u')/2$

(背面仍有題目,請繼續作答)

(where n is an integer.)

36. Appreciable quantities of a solute may be accommodated in the substitutional type of solid solution only when the difference in atomic radii between the two atom types is less than about:
Ⓐ ±35 % Ⓑ ±25 % Ⓒ ±15 % Ⓓ ±5 %

37. The yield strength increment due to the "conventional" substitutional solid-solution strengthening is proportional to
Ⓐ $c^{3/4}$ Ⓑ $c^{2/3}$ Ⓒ $c^{1/3}$ Ⓓ $c^{1/2}$
where c is the solute concentration.

38. Dislocation velocity is proportional to
Ⓐ $(\tau/2D)^m$ Ⓑ $(\tau/D)^m$ Ⓒ $(\tau^2/D)^m$ Ⓓ $(\tau^2/2D)^m$,
where τ is the applied shear stress, m is the dislocation velocity stress exponent, and D is the stress that yields a dislocation velocity of 1 cm/s.

39. In creep, the relationship between the strain rate (sr) and temperature (T) is
Ⓐ $sr = A \exp(-q/2kT)$ Ⓑ $sr^2 = A \exp(-q/kT)$
Ⓒ $sr^2 = A \exp(-q/2kT)$ Ⓓ $sr = A \exp(-q/kT)$.

40. In terms of the effects of inclusion on the growing grain size, which of the following is correct?
Ⓐ $R = 4r/(3f)$ Ⓑ $R = 2r/(3f)$ Ⓒ $R = 3r/(2f)$ Ⓓ $R = 2r/(f)$,
where R is the radius of curvature of the average grain, r is the radius of the inclusion, and f is the volume fraction of inclusion.

科目名稱： 量子物理導論

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Planck's constant h = 6.63×10^{-34} J.s,
Mass of an electron = 9.1×10^{-31} kg,
Speed of light = 3×10^{8} m/sec,
Charge of an electron = 1.6×10^{-19} C
Boltzmann constant = 1.381×10^{-23} J/K

41. J. J. Thomson's atomic model predicts
   Ⓐ uniform spread of small –e in a large +e,
   Ⓑ non-uniform spread of small –e in a large +e,
   Ⓒ a uniform mixture of small –e and large +e,
   Ⓓ a uniform mixture of equal-sized –e and +e.

42. Rutherford's atomic model pictures
   Ⓐ uniform spread of small –e in a large +e,
   Ⓑ a small nucleus in which the + particles and nearly all the mass are concentrated and the rest is a largely empty space,
   Ⓒ a lower limit of nucleus dimension,
   Ⓓ a uniform mixture of small –e and large +e.

43. As the wavelength decreases in typical atomic spectra, the spectral lines are
   Ⓐ closer and stronger, Ⓑ further apart and weaker,
   Ⓒ closer and weaker, Ⓓ further apart and stronger.

44. The wave function gives not only the information on position but also
   Ⓐ the linear momentum, Ⓑ the angular momentum,
   Ⓒ the energy, Ⓓ All of the above are true.

45. Under what condition is a dynamic quantity quantized?
   Ⓐ When it satisfies the eigenvalue equation.
   Ⓑ When it satisfies the uncertainty principle.
   Ⓒ When it satisfies the Schrödinger equation.
   Ⓓ When it satisfies the principle relativity.

46. The principal quantum numbers
   Ⓐ are non-negative. Ⓑ must be finite.

(背面仍有題目,請繼續作答)

Ⓒ represent energy quantization. Ⓓ can be half integers sometimes.

47. In the presence of an external magnetic field, the energy of an atomic state depends
Ⓐ on not only n but also m_l, Ⓑ only on n,
Ⓒ only on m_l, Ⓓ on n or m_l.

48. How much energy is required to excite a hydrogen atom from n = 1 to n = 3?
Ⓐ 10.2 eV, Ⓑ 12.1 eV, Ⓒ 0 eV, Ⓓ 13.6 eV.

49. When a hydrogen atom has an energy > -5×10^{-5} eV, then its principle quantum number n can be
Ⓐ 400, Ⓑ 450, Ⓒ 600, Ⓓ impossible.

50. Which of the following statement was NOT proposed by Einstein?
Ⓐ The meter stick is shorter in the direction of motion of the spacecraft at high speed.
Ⓑ The speed of light in free space is the same to all observers.
Ⓒ Time intervals and lengths are relative quantities.
Ⓓ The particle possesses the properties as a wave.

51. What the Gamma ray belongs to
Ⓐ proton Ⓑ electron Ⓒ neutron Ⓓ photon

52. Which of the following equations are incorrect? (E = total energy of the particle, m_o = rest mass, p = momentum, c = speed of light, KE = kinetic energy, Eo = m_oc^2)
Ⓐ $E = Eo + KE$ Ⓑ $E = mc^2$ Ⓒ $E = (m_o^2c^4 + p^2c^2)^{1/2}$ Ⓓ $E = (KE + p^2c^2)^{1/2}$

53. Which of the following statement is correct? (GeV = 1.6×10^{-10} Joule, c = speed of light) (1) GeV is an unit of energy; (2) GeV/c is an unit of momentum; (3) GeV/c^2 is an unit of mass.
Ⓐ (1) and (2) Ⓑ (2) and (3) Ⓒ (1), (2), and (3) Ⓓ only (1).

54. If a micro satellite (weight 1×10^{-6} Kg in earth) can be accelerated to a speed of v = 0.8c (c = speed of light). What is the total energy of this satellite?
Ⓐ 0.6×10^{-6} Kg c^2 Ⓑ 1.0×10^{-6} Kg c^2 Ⓒ 1.67×10^{-6} Kg c^2 Ⓓ 2.67×10^{-6} Kg c^2

55. The total angular momentum of a closed shell is
Ⓐ 0 Ⓑ $\hbar$ Ⓒ $\hbar/2$ Ⓓ $3\hbar/2$

56. The spectra that arise from transitions between the vibrational states are in the:

Ⓐ Microwave region Ⓑ Infrared region
Ⓒ Visible region Ⓓ Ultraviolet region

57. The energy of rotational quantum states can be written in terms of the quantum number J as $E_J=J(J+1)\hbar^2/2I$, where I is the moment of inertia. What is the number of states, $g(E_J)$?
Ⓐ J Ⓑ J+1 Ⓒ 2J+1 Ⓓ J^2

58. What is the energy of the lowest vibrational state?
Ⓐ 0 Ⓑ $h\nu_0/2$ Ⓒ $h\nu_0$ Ⓓ $3h\nu_0/2$

59. The wave function for the bound state of the H_2^+ molecular ion is:
Ⓐ Asymmetric Ⓑ Antisymmetric Ⓒ Symmetric Ⓓ None of these

60. Molecular bonds are classified by the Greek letters according to their angular momenta L about the bond axis. σ bond corresponds to:
Ⓐ L=0 Ⓑ L= 1 Ⓒ L=2 Ⓓ L= 3