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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　An electron moves in a circular path of radius 1.2 cm perpendicular to a uniform magnetic field. The speed of the electron is 10^6 m s⁻¹ What is the total magnetic flux encircled by the orbit?
　Ⓐ 2.15x10⁻⁵ wb　　Ⓑ 2.15x10⁻⁶ wb　　Ⓒ 2.15x10⁻⁷ wb　　Ⓓ 2.15x10⁻⁸ wb

2. In a magnetic field directed vertically upward, a particle initially moving north is deflected toward the west. What is the sign of the charge on the particle?
　Ⓐ negative　　Ⓑ positive　　Ⓒ neutral　　Ⓓ could be anything

3　A glass cube in air has a refractive index of 1.50. Parallel rays of light enter the top obliquely and then strike a side of the cube. Is it possible for the rays to emerge from this side?
　Ⓐ No　　Ⓑ Yes　　Ⓒ Likely　　Ⓓ Partially

4. A glass rod of refractive index 1.50 is ground and polished at both ends to hemispherical surfaces of 5 cm radius. When an object is placed on the axis of the rod, 20 cm from one end, the final image is formed 40 cm from the opposite end. What is the length of the rod?
　Ⓐ 20 cm　　Ⓑ 30 cm　　Ⓒ 40 cm　　Ⓓ 50 cm

5　Light of wavelength 589 nm from a distant source is incident on a slit 1.0 mm wide, and the resulting diffraction pattern is observed on a screen 2.0 m away. What is the distance between the two dark fringes on either side of the central bright fringe?
　Ⓐ 2.34 mm　　Ⓑ 2.36 mm　　Ⓒ 2.38 mm　　Ⓓ 2.40 mm

6. A solenoid is to be designed to produce a magnetic field of 0.1T at its center. The radius is to be 5 cm and the length 50 cm, and the available wire can carry a maximum current of 10 A. How many turns per unit length should the solenoid have?
　Ⓐ 6958 m⁻¹　　Ⓑ 7958 m⁻¹　　Ⓒ 8958 m⁻¹　　Ⓓ 9958 m⁻¹

7　Which of the following is not a vector?
　Ⓐ momentum　　Ⓑ velocity　　Ⓒ acceleration　　Ⓓ work

8　A diverging meniscus lens of 1.48 refractive index has concave spherical surfaces whose radii are

（背面仍有題目,請繼續作答）

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2.5 and 4 cm. What would be the position of the image if an object were placed 15 cm in front of the lens?

   Ⓐ 7.21 cm   Ⓑ -7.21 cm   Ⓒ 15 cm   Ⓓ -15 cm

9 What must the distance between point charge q1=32.0μC and point charge q2=-44.0μC for the electrostatic force between them to have a magnitude of 6.90N?

   Ⓐ 1 12   Ⓑ 1.36   Ⓒ 1.69   Ⓓ 2.01 m

10. The current in a single-loop circuit with one resistance R is 5.0A. When an additional resistance of 2.0Ω is inserted in series with R, the current drops to 4.0A. What is R?

   Ⓐ 7.0Ω   Ⓑ 8.0Ω   Ⓒ 9.0Ω   Ⓓ 10 0Ω

11 A magnetic field of magnitude 5.0×10^{-4} T is to be produced at a distance of 5 cm from a long straight wire. What current is required to produce this field

   Ⓐ 1.25 A   Ⓑ 12.5 A   Ⓒ 125 A   Ⓓ 250 A

12. An electromagnetic wave propagates in a ferrite material having K = 10 and K_M = 1000. Find the wavelength

   Ⓐ 2 cm   Ⓑ 2.5 cm   Ⓒ 3 cm   Ⓓ 4 cm

13 Camera A, having an f/8 lens 2.5 cm in diameter, photographs an object using the correct exposure of 1/100 s. What exposure should camera B used in photographing the same object if it has an f/4 lens 5 cm in diameter?

   Ⓐ 1/100 s   Ⓑ 1/200 s   Ⓒ 1/300 s   Ⓓ 1/400 s

14. The current in the windings on a toroid is 2.0 A. There are 400 turns and the mean circumferential length is 40 cm. With the aid of a search coil and charge-measuring instrument, the magnetic field is found to be 1.0 T Calculate the magnetic intensity

   Ⓐ 2000 A m⁻¹   Ⓑ 4000 A m⁻¹   Ⓒ 7.94x10⁵ A m⁻¹   Ⓓ 7.84x10⁵ A m⁻¹

15 A rugby kicker can give the ball an initial speed of 25m/s, what are the least elevation angle at which he can kick the ball to score a field goal from a point 50m in front of goalposts whose horizontal bar is 3.44m above the ground?

   Ⓐ 24°   Ⓑ 31°   Ⓒ 37°   Ⓓ 42°

16. A 5.20g bullet moving at 672m/s strikes a 700g wooden block at rest on a frictionless surface.

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The bullet emerges, traveling in the same direction with its speed reduced to 428m/s. What is the resulting speed of the block?

(A) 0.91m/s　　　(B) 1.34m/s　　　(C) 1.81m/s　　　(D) 2.45m/s

17 A meter stick with mass 0.56kg, about an axis perpendicular to the stick and located at the 20cm mark(treat the stick as a thin rod). What is the rotational inertia?

(A) 0.097　　　(B) 0.134　　　(C) 0.152　　　(D) 0.195 kg · m^2

18. A copper wire of cross-sectional area 2.00×10^{-6} m^2 and length 4.00m has a current of 2.00A uniformly distributed across that area. How much electrical energy is transferred to thermal energy in 30min?

(A) 223　　　(B) 233　　　(C) 243　　　(D) 253 J

19 An electric field of 320000N/C points due north at certain spot. What are the magnitude and direction of the force that acts on a charge of +4.0mC at this spot?

(A) 1280kN due to north　　　　　　　　(B) 1280kN due to south

(C) 1280N due to north　　　　　　　　(D) 1280N due to south

20. An electron is released from rest in a uniform electric field of magnitude 2.00×10^4N/C. The acceleration of the electron is

(A) 2.25　　　(B) 2.84　　　(C) 3.02　　　(D) 3.51 x10^{15} m/s^2

（背面仍有題目,請繼續作答）

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科目名稱 物理冶金

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21 The atomic volume of a vacancy in a copper crystal with the lattice constant of 0.36 nm is
Ⓐ 0.8 Ⓑ 1.2 Ⓒ 1.8 Ⓓ 2.2×10^{-29} m^3

22. For a supersaturated alloy, its maximum hardness
Ⓐ increases and the aging time required for the maximum hardness increases
Ⓑ decreases
Ⓒ increases and the aging time required for the maximum hardness decreases
Ⓓ remains unchanged as the aging temperature is decreased.

23. Identify the dislocation in terms of its Burgers vector that can cross-slip between (1,1,1) and (1,-1,1) of a FCC lattice
Ⓐ 1/2[-1,1,0] Ⓑ 1/2[-1,01] Ⓒ 1/2[1,1,0] Ⓓ 1/2[1,0,-1].

24. For the diamond crystal the forbidden diffraction plane is
Ⓐ (1,-1,1) Ⓑ (2,0,0) Ⓒ (4,0,0) Ⓓ (2,2,0).

25 Freezing can occur with no change in composition or temperature at these points which are called
Ⓐ eutectic Ⓑ eutectoid Ⓒ peritectic Ⓓ congruent points.

26. Ionic bonds are formed by which of the processes?
Ⓐ Electron sharing Ⓑ Electron transfer
Ⓒ Electron delocalization Ⓓ Electron localization.

27 Metallic bonds are formed by which of the processes?
Ⓐ Electron sharing Ⓑ Electron transfer
Ⓒ Electron delocalization Ⓓ Electron localization.

28. A polycrystalline sample is.
Ⓐ A polymer Ⓑ A powder Ⓒ Composed of small crystals Ⓓ A particle.

29. Which statement is correct?
Ⓐ Defects with a negative effective charge are donors,

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Ⓑ Defects with a positive effective charge are acceptors,

Ⓒ Defects with a positive effective charge are donors,

Ⓓ All are wrong.

30. What is the electrostatic bond strength of Al^{3+} in $MgAl_2O_4$?

　Ⓐ 1/5　　　　Ⓑ1/2　　　　Ⓒ1/3　　　　Ⓓ1/4.

31 For a screw dislocation, the shear strain around it is

　Ⓐ $b/(2\pi r)$　　Ⓑ $2b/(\pi r)$　　Ⓒ $b^2/(\pi r)$　　Ⓓ $b^2/(2\pi r)$,

where r is the radius of the Burgers circuit.

32. For the effects of inclusion on the growing grain size, which of the following is correct?

　Ⓐ $R = 3r^2/(4f)$　Ⓑ $R = 2r/(3f)$　Ⓒ $R = 4r/(3f)$　Ⓓ $R = 3r/(2f^2)$,

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.

33 The growth rate of the liquid-solid interface (V) in continuous growth is related to the undercooling (Tu) by

　Ⓐ $V = B\,Tu^2$　　Ⓑ $V^2 = B\,Tu$　　Ⓒ $V = B^2\,Tu$　　Ⓓ $V = B\,Tu$

34. The eutectic lamellar spacing (s) and the growth rate (R) are related by

　Ⓐ $s = (2B/AR)^{1/2}$　Ⓑ $s = (B/2AR)^{1/2}$　Ⓒ $2s = (B/AR)^{1/2}$　Ⓓ $s = (B/AR)^{1/2}$

35 Which of the followings is always correct

　Ⓐ true strain < engineering strain　　　Ⓑ true stress < engineering stress

　Ⓒ true strain > engineering strain　　　Ⓓ engineering stress < true stress

36. The concept of the 'valence' of an atom refers to:

　Ⓐ The charge on an ion　　　　　　Ⓑ The strength of the chemical bonds formed

　Ⓒ The combing ability of an atom　　Ⓓ The stability of an atom.

37 The geometrical factor in diffusion varies according to:

　Ⓐ The crystal structure　　　　　Ⓑ The number of defects present

　Ⓒ The size of the diffusion atoms　　Ⓓ The diffusion paths.

38. If we add Al ions in $BaTiO_3$, what do you expect?

（背面仍有題目,請繼續作答）

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 (A)Increase the electron concentration,　　 (B) Decrease the barium-vacancy concentration,

 (C) Decrease the titanium-vacancy concentration,(D)Increase the hole concentration.

39 Which one of the following would not increase the resistance to steady state diffusional creep?

 (A) Decrease grain size　　　　　　　　(B) Decrease temperature

 (C) decrease porosity in specimen　　　　(D)Decrease stress.

40. If the grain-boundary energy of a boundary between two iron crystals is 0.78 J/m^2, while that between iron and a second phase particle 0.40 J/m^2, what angle θ should occur at the junction?

 (A) 25.67　　　(B) 30.19　　　(C)43.56　　　(D)19.87°

科目名稱　量子物理導論

每題為 4 選 1，每一題答對得 1.5 分，答錯倒扣 0.375 分。

Planck's constant h=6.626×10^{-34} J·s Mass of an electron=9.110×10^{-31} Kg

Speed of light=2.998×10^8 m/sec Charge of an electron=1.602×10^{-19} C

41 How fast must a spacecraft travel relative to the earth for each day on the spacecraft to correspond to two days on the earth?

 (A) 2.0×10^8 m/s (B) 2.3×10^8 m/s (C) 2.6×10^8 m/s (D) 2.9×10^8 m/s

42 The idea that the entire universe is expanding is based on.

 (A) Photoelectric effect (B) Compton effect (C) Doppler effect (D) X-ray diffraction

43 An observer sees a box on the end of a spring oscillating rapidly with a period of T Another observer sitting inside the box also measures the period of the oscillating box. The second observer will find a period that is

 (A)equal to T (B)less than T (C)greater than T (D). There is no sufficient information to answer the question.

44. Classical average energy per standing wave is (k is Boltzmann's constant, T is temperature).

 (A) (1/2)kT (B) kT (C) (3/2)kT (D) 2kT

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45 Which of the following statements is not correct?

  Ⓐ Blackbody is the best absorber of thermal radiation.

  Ⓑ Blackbody is the best emitter of thermal radiation

  Ⓒ Blackbody must be made from carbon

  Ⓓ Blackbody radiation is the electromagnetic wave.

46. Which of the following statements is not correct:

  Ⓐ X-rays consist of high-energy photons

  Ⓑ X-rays are electromagnetic waves

  Ⓒ X-rays are generated when fast electrons impinge on matter

  Ⓓ none of above is correct

47 Which of the following statements is not correct:

  Ⓐ The rest mass of photon is zero

  Ⓑ The mass of blue light photon is larger than the mass of red light photon

  Ⓒ The mass of red light photon is larger than the mass of blue light photon

  Ⓓ none of above is correct

48. A positron collides head on with an electron and both are annihilated. Each particle had a kinetic energy of 1.00 MeV Find the wavelength of the resulting photons.

  Ⓐ 0.52 pm   Ⓑ 0.62 pm   Ⓒ 0.72 pm   Ⓓ 0.82 pm

49 The maximum wavelength for photoelectric emission in tungsten is 230 nm. What wavelength of light must be used in order for the electrons with maximum kinetic energy of 1.5 eV to be ejected?

  Ⓐ 120 nm   Ⓑ 140 nm   Ⓒ 160 nm   Ⓓ 180 nm

50. If a neutron in a box 0.01 nm across has the lowest allowed energy E_0, what is its second lowest allowed energy?

  Ⓐ $2E_0$ Ⓑ $3E_0$ Ⓒ $4E_0$ Ⓓ $5E_0$

51 Rutherford's atomic model failed because the model

  Ⓐ suggests a watermelon structure

  Ⓑ cannot give a correct description of electron's motion

  Ⓒ assumes that an atom is largely empty space

  Ⓓ only results in a false scattering formula useful for one-electron atom.

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52. If it takes 13.6 eV to remove an electron from a hydrogen atom, then the velocity of the electron is Ⓐ 1.2×10^7 m/s　Ⓑ 9.6×10^5 m/s　　Ⓒ 2.2×10^6 m/s　Ⓓ 3.6×10^4 m/s.

53. Bohr obtained his atomic model based on
　Ⓐ entirely classical physics　　　　　Ⓑ entirely quantum physics
　Ⓒ the de Broglie's matter wave concept　Ⓓ both classical physics and classical physics

54. The statement of "greater the quantum number, the closer quantum physics approaches classical physics" is
　Ⓐ true
　Ⓑ false
　Ⓒ true or false depending on the systems of interest
　Ⓓ true or false depending on the system energy.

55. A particle limited to the x axis is described by $\Psi = (3x^2)^{1/2}$ for $0 \le x \le 1$ and $\Psi = 0$ elsewhere. The probability P of finding the particle between x = 0.22 and x = 0.82 is
　Ⓐ 0.5407　　　Ⓑ 0.3807　　　　Ⓒ 0.6214　　　Ⓓ 0.4006

56. If a particle in a box L wide has a wave function $\Psi = (2/L)^{1/2} \sin(n\pi x/L)$, then what is the expectation value of its position in the box?
　Ⓐ L/3　　　Ⓑ L/4　　　　Ⓒ L/2　　　Ⓓ L/8.

57. The zero-point energy of a harmonic oscillator is
　Ⓐ hv　　　Ⓑ 0　　　　Ⓒ not existing　　　Ⓓ hv/2.

58. What is the degeneracy of the n = 3 energy level in the hydrogen atom?
　Ⓐ 9　　　Ⓑ 3　　　　Ⓒ 6　　　Ⓓ The degeneracy is a variable.

59. What is the most probable radius for the electron of a hydrogen atom in the 2p state?
　Ⓐ $3r^3$　　　Ⓑ $4r^3$　　　Ⓒ $2r^3$　　　Ⓓ r^3

60. What is the percentage difference between L and the maximum value of L_z for an atomic electron in the p state?
　Ⓐ 19%　　　Ⓑ 29%　　　Ⓒ 39%　　　Ⓓ 49%.