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請勿在本試題紙上作答，否則不予計分

普通物理共 50 題選擇題，每題答對得 2 分，答錯倒扣 0.4 分；滿分 100 分，倒扣至 0 分為止。

1. Find the moment of inertia (I) of a rod 4cm in diameter and 2m long, of mass 8kg, about a longitudinal axis passing through the center of the rod. I =Ⓐ2.67 $kg \cdot m^2$ Ⓑ10.7 $kg \cdot m^2$ Ⓒ1.6×10^{-3} $kg \cdot m^2$ Ⓓ 2.67×10^{-3} $kg \cdot m^2$ Ⓔ10.7×10^{-3} $kg \cdot m^2$.

2. Small blocks, each of mass m, are clamped at the ends and at the center of a light rigid rod of length L. Compute the moment of inertial(I) of the system about an axis perpendicular to the rod and passing through a point one-quarter of the length from one end. Neglect the moment of inertial of the rod.
I= Ⓐ$\frac{5}{8}mL^2$ Ⓑ$\frac{11}{16}mL^2$ Ⓒ$\frac{3}{4}mL^2$ Ⓓ$\frac{13}{16}mL^2$ Ⓔ$\frac{15}{16}mL^2$.

3. Water in an enclosed tank is subjected to a gauge pressure of $2 \times 10^4 Pa$, applied by compressed air introduced into the top of the tank. There is a small hole in the side of the tank 5m below the level of the water. Calculate the speed (v) with water escapes from the hole. v = Ⓐ23.6 m/s Ⓑ236 m/s Ⓒ59 m/s Ⓓ118 m/s Ⓔ11.8 m/s.

4. Water at 20 °C is pumped through a horizontal smooth pipe 15cm in diameter and discharges into the air. If the pump maintains a flow velocity of 30 cm/s. What is the discharge rate (in liters per second)? Ⓐ5.3 Ⓑ12.3 Ⓒ10.6 Ⓓ24.6 Ⓔ20.

5. A certain simple pendulum has a period on earth of 2.0 sec. What is its period on the surface of the moon, where g=1.7 m/s^2? Ⓐ4 sec Ⓑ1.2 sec Ⓒ8 sec Ⓓ2.4 sec Ⓔ4.8 sec.

6. Four passengers whose combined mass is 300kg are observed to compress the springs of an automobile by 5cm when they enter the automobile. If the total loas supported by the springs is 900kg, find the period of vibration of the loaded automobile. Ⓐ0.555sec Ⓑ0.666sec Ⓒ0.777sec Ⓓ0.888sec Ⓔ0.999sec.

7. What is the typical acceleration voltage of a TEM? Ⓐ 200 Volt Ⓑ 2,000 Volt Ⓒ 20,000 Volt Ⓓ 200,000 Volt Ⓔ 2,000,000 Volt

8. The synchrotron radiation facility is a Ⓐ high precision STM Ⓑ high resolution TEM Ⓒhigh intensity X-ray source Ⓓ nuclear power plant Ⓔ high energy electron source

(背面仍有題目，請繼續作答)

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9. Which of the following statements on a wave function of a moving particle is in-correct? Ⓐ the square of the absolute value of amplitude reflects the probability of finding the particle at a particular place and a particular time. Ⓑ the amplitude reflects the probability of finding the particle at a particular place and all time. Ⓒ An electron and a proton have the same kinetic energy, which means that the de Broglie wavelengths of proton is shorter than that of electron. Ⓓ the group velocity of the wave can not be faster than the speed of light. Ⓔ the faster the moving velocity of a particle, the shorter the de Broglie wavelength.

10. With knowing the ionization energy of a hydrogen atom, which of the following theory can be used to estimate the radius of a hydrogen atom? Ⓐ Heisenberg uncertainty principle Ⓑ de Broglie wave Ⓒ Compton effect Ⓓ Special relativity Ⓔ Photoelectric effect .

11. The unit of Planck constant is same with which of the following physical property. Ⓐ Energy Ⓑ Momentum Ⓒ Electrical Conductivity Ⓓ Photoelectric effect Ⓔ Angular momentum

12. Calculate the ratio of the electrical force to the gravitational force exerted by a proton on an electron in a hydrogen atom. (The Coulomb and Gravitational constants are 8.99×10^{9} N·m^2/C^2 and 6.67×10^{-11} N·m^2/kg^2, respectively. The proton and electron masses are 1.67×10^{-27} and 9.11×10^{-31} kg, respectively. The charge of electron is 1.60×10^{-19} C)

Ⓐ 2×10^{9} Ⓑ 2×10^{19} Ⓒ 2×10^{29} Ⓓ 2×10^{39} Ⓔ 2×10^{49}

13. An electron enters a uniform electrical field E=2000 N/C with an initial velocity V=10^6 m/s and the direction perpendicular to E. What is the ratio of the electrical force to the gravitational force acting on the electron? (The charge and mass of an electron are 1.60×10^{-19} C and 9.11×10^{-31} kg, respectively.)

Ⓐ 3.6×10^{11} Ⓑ 3.6×10^{12} Ⓒ 3.6×10^{13} Ⓓ 3.6×10^{14} Ⓔ 3.6×10^{15}

14. A particle with a charge $+q$ is separated from another particle of the charge $-q$ by a distance l. How is the electrical dipole moment p defined?

Ⓐ $p=q\cdot l$, which is a scalar, independent of direction.
Ⓑ $p=2q\cdot l$, which is a scalar, independent of direction.
Ⓒ $p=q\cdot l$, which is a vector with the direction pointing from $+q$ to $-q$.
Ⓓ $p=q\cdot l$, which is a vector with the direction pointing from $-q$ to $+q$.
Ⓔ $p=2q\cdot l$, which is a vector with the direction pointing from $+q$ to $-q$.

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15. Three charges, $+q$, $+Q$, and $-Q$, are places at the corners of an equilateral triangle with $+q$ on the top, $+Q$ on the left, and $-Q$ on the right. The net electrical force on the charge $+q$ due to the other two is:
Ⓐ horizontal to the left Ⓑ horizontal to the right Ⓒ vertically up Ⓓ vertically down
Ⓔ zero

16. An electrical dipole is placed in a uniform electrical field. Which of the following statements is correct? Ⓐ The net force on the dipole is zero, but there is a torque that tends to align the dipole in the direction of the field. Ⓑ The net force on the dipole is zero, but there is a torque that tends to align the dipole in the direction opposite to the field. Ⓒ The net force on the dipole is zero, but there is a torque that tends to align the dipole in the direction vertical to the field. Ⓓ There is a net force on the dipole, but the torque is zero. Ⓔ Both the net force and the torque are zero.

17. A metal bar is connected to ground through a switch that is closed. Someone places a positive charge $+Q$ near to the metal bar and then opens the switch. If we remove the charge $+Q$ afterwards, what is the charge state of the metal bar?
Ⓐ It is positively charged. Ⓑ It is negatively charged. Ⓒ It is uncharged. Ⓓ It depends on the initial charge state of the metal bar before $+Q$ was placed nearby. Ⓔ None of the above.

18. For a real gas: Ⓐ It follows **PV=RT** Ⓑ We can describe its behavior by **P(V-b')=RT**, where **b'** is the volume of gas particles. Ⓒ Gas particles have volume thus **PV=RT** fails when **P** approaches zero.
Ⓓ $\left(\frac{\partial U}{\partial V}\right)_T$ is zero. Ⓔ Compressibility factor (**Z**) is not unity.

19. For regular and subregular solutions: Ⓐ Both are non-ideal solutions. Ⓑ $\Delta H^M = \Omega X_A X_B$, where Ω is a constant. Ⓒ The expression for molar excess Gibbs free energy of formation, G^{XS}, is an empirical equation. Ⓓ $\Delta \bar{S}_i^M = -R \ln X_i$ Ⓔ All of the above.

20. For a non-ideal gas: Ⓐ At increasing temperature, pressure $P = \sqrt{fP_{ideal}}$, where **f** is fugacity.
Ⓑ Volume can be expressed as $V = \frac{RT}{P} - \alpha$, where α is a measure of deviation from ideality.
Ⓒ dG=RTd*ln(1/f)* Ⓓ The work done by this gas in a reversible, isothermal expansion from V_1 to V_2 is w=RT*ln*(V_2/V_1). Ⓔ Fugacity is the difference of pressure between non-ideal and ideal gases.

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21. The α-function was introduced in the determination of activity, so that: Ⓐ We can use Gibbs-Duhem equation to calculate activity without uncertainty. Ⓑ The behavior of a non-ideal solution can explained with a statistical model. Ⓒ The behavior of solute obeys Henry's law. Ⓓ We can apply van der Waals equation to non-ideal solutions. Ⓔ None of the above.

22. In the thallium-tin system, the activity of Tl ($\mathbf{a_{Tl}}$) is 0.4 for $\mathbf{X_{Tl}} = 0.2$, and $\mathbf{T}$=352°C, so we know: Ⓐ Thallium shows a negative deviation from Raoultian ideal behavior. Ⓑ Tl and Sn are immiscible. Ⓒ The mixing process is exothermic. Ⓓ Tl-Sn is non-ideal solution, $\gamma_{Tl} > 1$ Ⓔ None of the above.

23. A wire carries a steady current of 2 A. The charge that passes a cross section in 2 s is: Ⓐ 3.2×10^{-19} C Ⓑ 6.4×10^{-19} C Ⓒ 1C Ⓓ 2C Ⓔ 4C

24. A conductor is distinguished from an insulator with the same number of atoms by the number of: Ⓐ nearly free atoms Ⓑ electrons Ⓒ nearly free electrons Ⓓprotons Ⓔ molecules

25. Particles 1, with charge q_1, and 2, with charge q_2, are on the x axis, with particle 1 at $x = d$ and particle 2 at $x = -2d$. For the net force on a third charged particle, at the origin, to be zero, q_1 and q_2 must be related by q_2 =: Ⓐ $2q_1$ Ⓑ $4q_1$ Ⓒ $-2q_1$ Ⓓ $-4q_1$ Ⓔ $-q_1/4$

26. Choose the correct statement concerning electric field lines: Ⓐ field lines may cross Ⓑ field lines are close together where the field is large Ⓒ field lines point away from a negatively charged particle Ⓓ a charged point particle released from rest moves along a field line Ⓔ none of these are correct

27. An isolated charged point particle produces an electric field with magnitude E at a point 2m away from the charge. A point at which the field magnitude is E/4 is: Ⓐ 1m away from the particle Ⓑ 0.5m away from the particle Ⓒ 2m away from the particle Ⓓ 4m away from the particle Ⓔ 8m away from the particle

28. Two point particles, with charges of q_1 and q_2, are placed a distance r apart. The electric field is zero at a point P between the particles on the line segment connecting them. We conclude that: Ⓐ q_1 and q_2 must have the same magnitude and sign Ⓑ P must be midway between the particles Ⓒ q_1 and q_2 must have the same sign but may have different magnitudes Ⓓ q_1 and q_2 must have equal magnitudes and opposite signs Ⓔ q_1 and q_2 must have opposite signs and may have different magnitudes

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29. Which of the following statements is true? Ⓐ Maxwell's equations apply only to fields that are constant in time. Ⓑ Electromagnetic waves are longitudinal waves. Ⓒ The electric and magnetic fields are out of phase in an electromagnetic wave. Ⓓ The electric- and magnetic-field vectors and are equal in magnitude in an electromagnetic wave. Ⓔ None of these statements is true.

30. The visible portion of the electromagnetic spectrum is closest to which of the following intervals? Ⓐ 200 to 500 nm Ⓑ 300 to 600 nm Ⓒ 400 to 700 nm Ⓓ 500 to 800 nm Ⓔ 600 to 900 nm

31. Electromagnetic waves are produced when Ⓐ free electric charges accelerate. Ⓑ conduction electrons move with a constant drift velocity in a conductor. Ⓒ a conductor moves with constant velocity through a magnetic field. Ⓓ electrons bound to atoms and molecules make transitions to higher energy states. Ⓔ All of these are correct.

32. How much does the energy stored in an inductor change if the current through the inductor is doubled? Ⓐ it is the same Ⓑ it is doubled Ⓒ it is quadrupled Ⓓ it is halved Ⓔ it is quartered

33. Two heaters are plugged into the same 120-V AC outlet. If one heater is rated at 1100 W, then what can be the maximum rating of the second heater in order not to exceed the 20 A trip rating on the circuit? Ⓐ 1100 W Ⓑ 1300 W Ⓒ 1200 W Ⓓ 2400 W Ⓔ 920 W

34. If Si and Ge form an ideal solid solution at 730 °C, the molar Gibbs free energy of the (Si,Ge) solid solution at 730 °C. G^o_{Ge} and G^o_{Si} are -55000 and -40000 (J/mol), respectively. What is the range of the value of ΔG^M at $X_{Si} = 0.5$ in J/mol? (ΔG^M is the Gibbs free energy of mixing; Given $\ln 2 \cong 0.69$)
Ⓐ$-12{,}000 \leq \Delta G^M_{X_{Si}=0.5} < -6{,}000$, Ⓑ$-6{,}000 \leq \Delta G^M_{X_{Si}=0.5} < 0$, Ⓒ$\Delta G^M_{X_{Si}=0.5} = 0$,
Ⓓ$0 < \Delta G^M_{X_{Si}=0.5} \leq 6{,}000$, Ⓔ$6{,}000 < \Delta G^M_{X_{Si}=0.5} \leq 12{,}000$.

35. If Si and Ge form an ideal solid solution at 730 °C, the molar Gibbs free energy of the (Si,Ge) solid solution at 730 °C. G^o_{Ge} and G^o_{Si} are -55000 and -40000 (J/mol), respectively. What is the range of the value of ΔS^M at $X_{Si} = 0.5$ in J/mol·K? (ΔS^M is the entropy of mixing; Given $\ln 2 \cong 0.69$)
Ⓐ$-12 \leq \Delta S^M_{X_{Si}=0.5} < -6$, Ⓑ$-6 \leq \Delta G^M_{X_{Si}=0.5} < 0$, Ⓒ$\Delta G^M_{X_{Si}=0.5} = 0$, Ⓓ$0 < \Delta G^M_{X_{Si}=0.5} \leq 6$,
Ⓔ$6 < \Delta G^M_{X_{Si}=0.5} \leq 12$.

(背面仍有題目，請繼續作答)

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36. If Si and Ge form an ideal solid solution at 730 °C, the molar Gibbs free energy of the (Si,Ge) solid solution at 730 °C. G^o_{Ge} and G^o_{Si} are -55000 and -40000 (J/mol), respectively. What is the range of the value of μ_{Si} at $X_{Si} = 0.5$ in J/mol? (μ_{Si} is the chemical potential of Si; Given $\ln 2 \cong 0.69$)
Ⓐ$-100{,}000 \leq \mu_{Si}|_{X_{Si}=0.5} < -50{,}000$, Ⓑ$-50{,}000 \leq \mu_{Si}|_{X_{Si}=0.5} < 0$, Ⓒ$\mu_{Si}|_{X_{Si}=0.5} = 0$,
Ⓓ $0 < \mu_{Si}|_{X_{Si}=0.5} \leq 50{,}000$, Ⓔ$50{,}000 < \mu_{Si}|_{X_{Si}=0.5} \leq 100{,}000$.

37. If Si and Ge form an ideal solid solution at 730 °C, the molar Gibbs free energy of the (Si,Ge) solid solution at 730 °C. G^o_{Ge} and G^o_{Si} are -55000 and -40000 (J/mol), respectively. What is the range of the value of μ_{Ge} at $X_{Si} = 0.5$ in J/mol? (μ_{Ge} is the chemical potential of Ge; Given $\ln 2 \cong 0.69$)
Ⓐ$-100{,}000 \leq \mu_{Ge}|_{X_{Si}=0.5} < -50{,}000$, Ⓑ$-50{,}000 \leq \mu_{Ge}|_{X_{Si}=0.5} < 0$, Ⓒ$\mu_{Ge}|_{X_{Si}=0.5} = 0$,
Ⓓ$0 < \mu_{Ge}|_{X_{Si}=0.5} \leq 50{,}000$, Ⓔ$50{,}000 < \mu_{Ge}|_{X_{Si}=0.5} \leq 100{,}000$.

38. If Si and Ge form an ideal solid solution at 730 °C, the molar Gibbs free energy of the (Si,Ge) solid solution at 730 °C. G^o_{Ge} and G^o_{Si} are -55000 and -40000 (J/mol), respectively. What is the range of the value of a_{Si} at $X_{Si} = 0.7$ in J/mol? (a_{Si} is the activity of Si; Given $\ln 2 \cong 0.69$)
Ⓐ$-1 \leq a_{Si}|_{X_{Si}=0.7} < -0.5$, Ⓑ$-0.5 \leq a_{Si}|_{X_{Si}=0.7} < 0$, Ⓒ$a_{Si}|_{X_{Si}=0.7} = 0$, Ⓓ$0 < a_{Si}|_{X_{Si}=0.7} \leq 0.5$,
Ⓔ$0.5 < a_{Si}|_{X_{Si}=0.7} \leq 1$.

39. An egg, initially at rest, is dropped onto a concrete surface and breaks. With the egg treated as the system, what is the sign of work? (Given: $\Delta U + \Delta E_P + \Delta E_K = Q - W$) Ⓐpositive; done by the egg, Ⓑpositive; done on the egg, ⒸNo work (equal to zero), Ⓓnegative; done by the egg, Ⓔnegative; done on the egg.

40. An electron was accelerated from rest through a potential difference of 9900V. What is its speed?
Ⓐ2.9×10^6m/s Ⓑ300m/s Ⓒ5.9×10^7m/s Ⓓ 3×10^9m/s Ⓔ59nm/s

41. Electric Current is a measure of Ⓐrate at which charges pass through a point ⒷForce that moves charges past a point ⒸEnergy required to move charge past a point ⒹResistance to the movement past a point Ⓔ Acceleration of charges

42. When a current of 3mA exists on a wire, the amount of charge that passes a certain point within 10s is Ⓐ3×10^{-3}C Ⓑ 3×10^{-2}J Ⓒ3×10^{-2}C Ⓓ 3C Ⓔ 30W

43. What is the SI unit for the permittivity ε_0? Ⓐ W/s Ⓑ F/m Ⓒ Cs Ⓓ Vs/m^2 Ⓔ kg m/s^2

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44. The capacitance of a parallel plate capacitor is Ⓐ directly proportional to the distance between plates Ⓑinversely proportional to the square of the distances between plates Ⓒdirectly proportional to the thickness of the plates Ⓓdirectly proportional to the plate area ⒺAll of the above

45. Suppose the earth were suddenly to cease circling the sun. The gravitational force would then pull it toward the sun. What would earth's speed as it crashed?[R_s: radius of sun, R_e radius of earth, r_1: initial distance between earth and sun, G: gravitational constant, M_s: mass of sun, M_e: mass of earth]

Ⓐ$v=\sqrt{2GM_s\left(\frac{1}{R_s+R_e}-\frac{1}{r_1}\right)}$ Ⓑ$v=\sqrt{4GM_s\left(\frac{1}{R_s+R_e}-\frac{1}{r_1}\right)}$ Ⓒ$v=\sqrt{2GM_s\left(\frac{1}{R_s+R_e}+\frac{1}{r_1}\right)}$

Ⓓ$v=\sqrt{2GM_s\left(\frac{1}{R_s-R_e}-\frac{1}{r_1}\right)}$ Ⓔ$v=\sqrt{4GM_s\left(\frac{1}{R_s+R_e}+\frac{1}{r_1}\right)}$

46. How much work, W, must be done to boost a communication satellite with mass m from a low earth orbital with height equal to r1 to a geosynchronous orbital r2?
[G: gravitational constant, Me: mass of earth, Re radius of earth]

Ⓐ$W=\frac{1}{2}(GM_em)(\frac{1}{r_2+R_e}-\frac{1}{r_1+R_e})$ Ⓑ$W=\frac{1}{2}(-GM_em)(\frac{1}{r_2+R_e}+\frac{1}{r_1+R_e})$ Ⓒ$W=\frac{1}{2}(-GM_em)\left(\frac{1}{r_2+R_e}-\frac{1}{r_1+R_e}\right)$

Ⓓ$W=\frac{1}{2}(GM_em)(\frac{1}{r_2+R_e}+\frac{1}{r_1+R_e})$ Ⓔ$W=\frac{1}{2}(-GM_em)(\frac{1}{r_2-R_e}-\frac{1}{r_1-R_e})$

47. An object on a spring oscillates with a period of 4.0 s and an amplitude of 10 cm. At time t=0, it is 5.0 cm to the left of equilibrium and moving to the left. What is its position and direction of motion at t=2.0 s? Ⓐ2.0 cm to the right of equilibrium and moving to the right Ⓑ5.0 cm to the left of equilibrium and moving to the left Ⓒ2.0 cm to the left of equilibrium and moving to the right Ⓓ5.0 cm to the right of equilibrium and moving to the right Ⓔ2.0 cm to the right of equilibrium and moving to the left

48. Which one of the following functions can be used to model a damped oscillation?
Ⓐ$Ae^{\frac{b}{2m}t}\cos(wt+\theta)$ Ⓑ$Ae^{\frac{-b}{2m}t}\cos(wt+\theta)$ Ⓒ$A\cos(wt+\theta)$ Ⓓ$Ae^{\frac{b}{2m}t}\sin(wt+\theta)$ ⒺNone of above

49. A 300 kg mass on a 25-m long string oscillates as a pendulum. It has a speed of 14.14 m/s as it pass through the lowest point. What maximum angle does the pendulum reach? [g=10 m/s^2]
Ⓐ10° Ⓑ20° Ⓒ60° Ⓓ30° Ⓔ15°

(背面仍有題目，請繼續作答)

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50. A 2.0-m-long string with a mass of 4.0 g is tied to a wall at one end, stretched horizontally to a pulley 1.6 m away, then tie to a physics book of mass M that hangs from the string. Experiments find that a wave pulse travels along the stretched string at 40 m/s. What is the mass of the book? [g=10 m/s^2]
Ⓐ0.32 kg Ⓑ0.22 kg Ⓒ3.2 kg Ⓓ2.0 kg Ⓔ0.8 kg