單選題,以 2B 鉛筆劃在答案卡上;答對一題得 1 分,答錯一題倒扣 0.25 分,未答不計分。

普通物理

1. 在警匪追逐戰中,歹徒搭乘平台火車企圖逃跑,假設平台車質量為 200 kg,原始速度為 3 m/s。一名英勇的警察(其質量約為 50 kg),從垂直方向跳上平台車,想要逮住歹徒。在他跳上平台車之後,車速為_____ m/s。

(A)3.6　(B)2.4　(C)1.8　(D)1.2　(E)0.6

2. 在地球上空有很多太空垃圾。有一天,大雄觀察兩塊太空垃圾分別以 R 和 4R(距地心距離)軌道繞地球運行,那麼在雷達螢幕上,他們的速度分別為 v 和____v。

(A)4　(B)2　(C)1　(D)$\frac{1}{2}$　(E)$\frac{1}{4}$

3. 有一天小叮噹和大雄坐上時光旅行機去玩。小叮噹注意到在靜止時鉛直的擺錘,因為加速度而和鉛直線成 30°角。他考大雄這時旅行機的加速度為_____×g (g 是重力加速度)。

(A)1　(B)$\frac{1}{2}$　(C)$\frac{1}{\sqrt{3}}$　(D)$\frac{\sqrt{3}}{2}$　(E)2

4. 宜靜有一次把一定量的理想氣體,從 0℃加溫至 273℃,同時發現氣體體積從 $0.1m^3$ 增加至 $0.2m^3$。所以聰明的宜靜會記下

(A)壓力增加　(B)壓力減小　(C)密度增加　(D)密度減小　(E)資料不足,無從判斷

5. 大雄正在研究一塊隔熱磚的熱傳導,他發現熱流傳導速率是 J。如果是另一塊厚度加倍,面積減半的相同隔熱磚,其兩面溫差亦加倍的情形下,熱流傳導速率會是_____J。

(A)2　(B)1　(C)$\frac{1}{2}$　(D)8　(E)$\frac{1}{8}$

6. 宜靜正在教大雄比熱的問題,她問道:莫耳理想雙原子氣體,在固定壓力下的比熱為何?大雄該回答_____R(R 是理想氣體常數)才不致顯得很呆?

(A)$\frac{7}{2}$　(B)$\frac{5}{2}$　(C)$\frac{3}{2}$　(D)4　(E)2

7. 大雄在車庫裏修車子,發現引擎說明書描述其工作溫度是在 100℃及 0℃之間。假設引擎設計者想要儘可能提高引擎效能,那大概效能值約為_____%。

(A)70　(B)60　(C)45　(D)25　(E)10

8. 在新竹火車站等車時,小叮噹對於火車啟動時輪子吱吱作響很有興趣。請問火車正要啟動時,車輪與軌道接觸點的對地速度是

(A)向前　(B)向後　(C)向左上　(D)向右上　(E)零

9. 宜靜在一光滑斜面上(傾角為 30°)測量一木塊作簡諧運動的週期。木塊質量為 M,彈簧的彈性係數為 K.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

，宜靜量到的運動週期 $T = \underline{\hspace{2cm}} \times 2\pi \sqrt{M/K}$

(A) $\sqrt{3}$　　(B) $\sqrt{3}/2$　　(C) 2　　(D) $\frac{1}{2}$　　(E) 1

10. 宜靜有一天偷看大雄上課筆記，發現大雄筆記裏對重力質量的描述錯誤百出。下列為筆記片段，你能指出那一段是正確的嗎？
    (A) 在太空中，重力質量會變得很小
    (B) 根據相對論，重力質量是不隨運動狀態改變的
    (C) 愛因斯坦說，重力質量就是慣性質量
    (D) 當一個物體離宇宙其它物體們都很遠時，其重力質量為零
    (E) 我大概睡著了，上面抄的都是錯的

普通化學

11. The high boiling point of water in comparison to H2S is best explained by the concept of
    (A) London forces　　(B) dipole-dipole interactions　　(C) polarizability　　(D) hydrogen bonding
    (E) none of the above

12. Which of the following has a dipole moment?
    (A) SO_3　　(B) CF_4　　(C) CO_2　　(D) SO_2　　(E) none of the above.

13. Which of the following transition elements is most likely to exhibit a +3 oxidation number in its
    compounds.　　(A) zinc　　(B) cadmium　　(C) copper　　(D) manganese　　(E) none of the above.

14. Rust is formed by the action of water and oxygen on iron.　　The formula for rust is
    (A) FeO　　(B) Fe_2O_3　　(C) $Fe_2O_3 \cdot H_2O$　　(D) FeO_2　　(E) none of the above.

15. Under which condition is a reaction always in equilibrium?
    (A) $\triangle G = 0$　　(B) $\triangle H = 0$　　(C) $\triangle S = 0$　　(D) $\triangle H = \triangle S$　　(E) none of the above.

16. A chemical reaction will always be spontaneous when
    (A) $\triangle H = -$ and $\triangle S = -$　　(B) $\triangle H = +$ and $\triangle S = +$　　(C) $\triangle G = +$　　(D) $\triangle H = -$ and $\triangle S = +$
    (E) none of the above.

17. Which of the following reactions has a negative change in entropy?
    (A) $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$　　(B) $2HgO_{(s)} \rightarrow 2 Hg_{(l)} + O_{2(g)}$　　(C) $5H_{2(g)} + 4C_{(s)} \rightarrow C_4H_{10(g)}$
    (D) $2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$　　(E) none of the above.

18. Given: $N_{2(g)} + 2O_{2(g)} \rightarrow 2 NO_{2(g)}$　$\triangle H^0 = 3.6$ kJ/mol　and　$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$ $\triangle H^0 = -6.7$ kJ/mol.
    What is the standard enthalpy (kJ/mol) of formation for nitric oxide, NO?
    (A) 10.3　　(B) 3.1　　(C) 5.15　　(D) –20.6　　(E) none of the above.

19. Draw the lewis structure for benzene, C_6H_6 (the carbons should be connected in a six-membered ring).
    What is the bond order of the carbon-carbon bond?
    (A) 1　　(B) 1.25　　(C) 1.67　　(D) 1.5　　(E) none of the above.

20. Consider the reaction, CaC_2 + water $\rightarrow$ products.　　Which of the following is a product?
    (A) Ca　　(B) CH_4　　(C) acetylene $HC \equiv CH$　　(D) H_2　　(E) none of the above.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

工程數學

21. Which of the following equations is INCORRECT?

    (A) $f(x,y) = x\sin y$, then $\dfrac{\partial f}{\partial x} = \sin y$

    (B) $f = f(x,y,t)$ and $x = x(t), y = y(t)$, then $\dfrac{df}{dt} = \dfrac{\partial f}{\partial x}\cdot\dfrac{dx}{dt} + \dfrac{\partial f}{\partial y}\cdot\dfrac{dy}{dt} + \dfrac{\partial f}{\partial t}$

    (C) $x = x(u,v), y = y(u,v)$, then $\dfrac{\partial(x,y)}{\partial(u,v)}\cdot\dfrac{\partial(u,v)}{\partial(x,y)} = 1$

    (D) a, b are constants, then $\dfrac{d}{dt}\int_a^b f(x,t)\,dx = \int_a^b \dfrac{\partial}{\partial t} f(x,t)\,dx$

    (E) none of the above

22. Which of the following vectors is normal to the surface $2x^2 + y^2 + z^2 = 15$ at $(-1, 2, -3)$?

    (A) $-\hat{\mathbf{i}} + 2\hat{\mathbf{j}} - 3\hat{\mathbf{k}}$　(B) $\hat{\mathbf{i}} + 2\hat{\mathbf{j}} - 3\hat{\mathbf{k}}$　(C) $2\hat{\mathbf{i}} - 2\hat{\mathbf{j}} + 3\hat{\mathbf{k}}$　(D) $2\hat{\mathbf{i}} + 2\hat{\mathbf{j}} + 3\hat{\mathbf{k}}$　(E) $-2\hat{\mathbf{i}} + \hat{\mathbf{j}} - 3\hat{\mathbf{k}}$

23. The length $s(\tau)$ of the curve $\mathbf{R}(\tau) = \sin\tau\,\hat{\mathbf{i}} - \sqrt{3}\sin\tau\,\hat{\mathbf{j}} - 2\cos\tau\,\hat{\mathbf{k}}$, $0 \le \tau$ is equal to

    (A) τ　(B) 2τ　(C) 3τ　(D) 4τ　(E) 8τ.

24. The integral $\iint_R |xy|\,dx\,dy$ in the region R defined $0 \le x^2 + y^2 \le 1$ is equal to

    (A) 1　(B) $\dfrac{1}{2}$　(C) 2　(D) $\dfrac{1}{4}$　(E) 4

25. The spherical coordinates (ρ, ϕ, θ) and the Cartesian coordinates (x, y, z) are related by $x = \rho\sin\phi\cos\theta$, $y = \rho\sin\phi\sin\theta$, $z = \rho\cos\phi$, then the Jacobian $\dfrac{\partial(\rho,\phi,\theta)}{\partial(x,y,z)}$ is equal to

    (A) $\dfrac{1}{\rho^2\cos\theta}$　(B) $\dfrac{1}{\rho^2\cos\phi}$　(C) $\dfrac{1}{\rho^2\sin\phi}$　(D) $\dfrac{1}{\rho^2\sin\theta}$　(E) none of the above

26. A vector field $\mathbf{A}(x,y,z) = xy\hat{\mathbf{i}} + yz\hat{\mathbf{j}} - xy^2\hat{\mathbf{k}}$, then $\nabla\cdot\mathbf{A}$ is equal to

    (A) $y + z$　(B) $x + y$　(C) $y + xz$　(D) $y + z - 2xy$　(E) $2y - z$

27. If U is a scalar field, $\mathbf{A}, \mathbf{B}$ are vector fields, dv the volume element, and da the area element, which of the following equations is INCORRECT?

    (A) $\nabla\times(\mathbf{A}\times\mathbf{B}) = \mathbf{A}(\nabla\cdot\mathbf{B}) - \mathbf{B}(\nabla\cdot\mathbf{A})$　(B) $\nabla\times(U\mathbf{A}) = \nabla U \times \mathbf{A} + U\nabla\times\mathbf{A}$

    (C) $\nabla\times\nabla U = \mathbf{0}$　(D) $\int(\nabla\cdot\mathbf{A})\,dv = \oint\mathbf{A}\cdot da$　(E) $\int(\nabla\times\mathbf{A})\cdot da = \oint\mathbf{A}\cdot d\mathbf{s}$

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

28. The Sturm-Liouville equation has the form $[p(x)y']' + q(x)y + \lambda w(x)y = 0, (a < x < b)$. For the differential equation $y'' - 2y' + \lambda y = 0, (0 < x < \pi)$, which of the following function, when multiplied into the above equation, can turn it into a Sturm-Liouville equation.

(A) x　(B) $-x$　(C) e^x　(D) e^{-x}　(E) e^{-2x}

29. The Fourier transform of a function $f(x)$ is defined by $F\{f(x)\} = \int_{-\infty}^{\infty} f(x)e^{-i\omega x}\, dx$. If $H(x)$ is the Heaviside step function and $a > 0$, $F\{H(x)\, e^{-ax}\}$ is equal to

(A) $\dfrac{1}{a+i\omega}$　(B) $\dfrac{1}{a-i\omega}$　(C) $\dfrac{2}{a+i\omega}$　(D) $\dfrac{2}{a-i\omega}$　(E) $\dfrac{2}{a+i\omega}$

30. It is known that $\int_{-\infty}^{\infty} e^{-x^2}\, dx = \sqrt{\pi}$, then $F\{e^{-ax^2}\}$ $(a > 0)$ is equal to

(A) $\sqrt{\dfrac{\pi}{a}}e^{\frac{\omega^2}{4a}}$　(B) $\sqrt{\dfrac{\pi}{a}}e^{-\frac{\omega^2}{4a}}$　(C) $\dfrac{\sqrt{\pi}}{a}e^{\frac{\omega^2}{4a^2}}$　(D) $\dfrac{\sqrt{\pi}}{a}e^{-\frac{\omega^2}{4a^2}}$　(E) $\dfrac{\sqrt{\pi}}{a}e^{\frac{a^2\omega^2}{4}}$
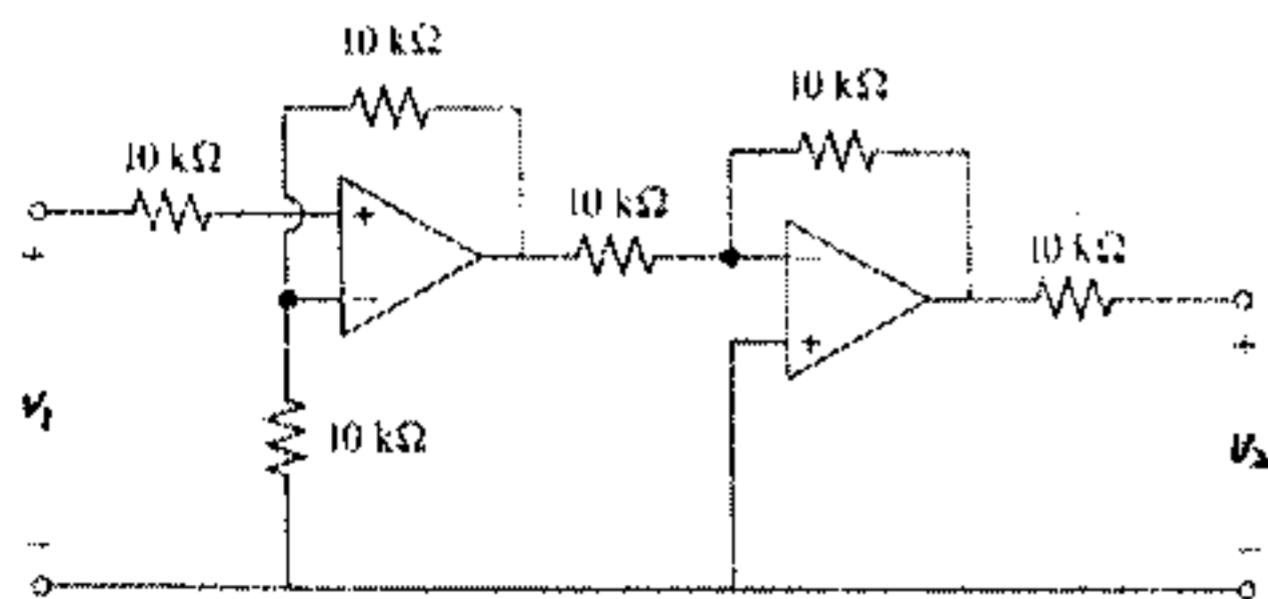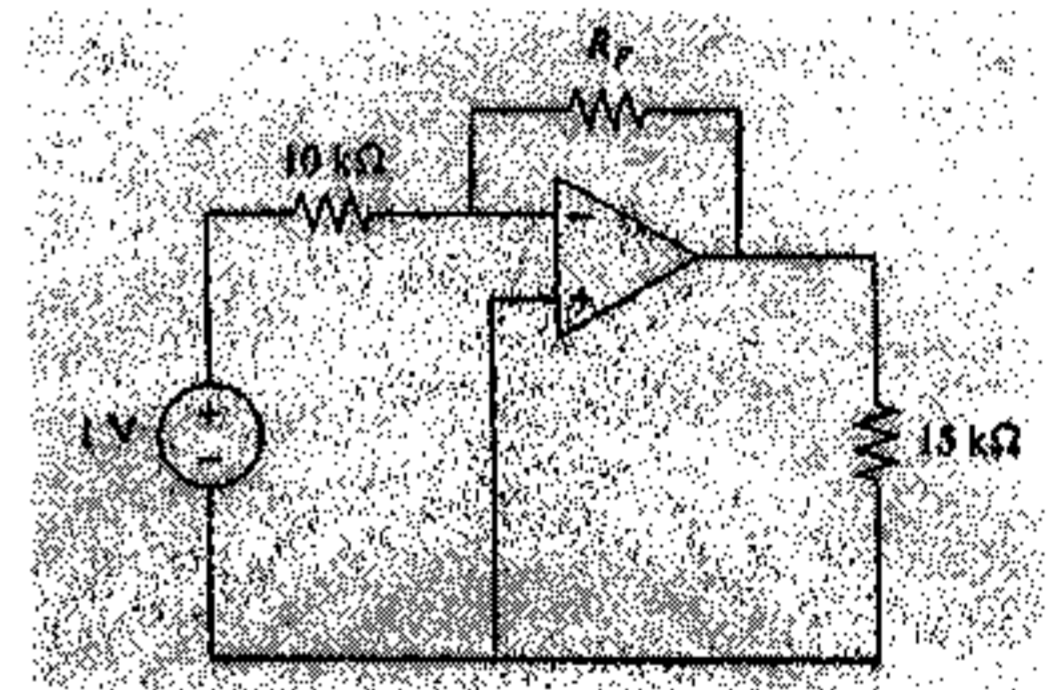
應用電子學

31. If we wish to supply 0.5 mW of power to the 15 kΩ load, $R_F = ?(k\Omega)$
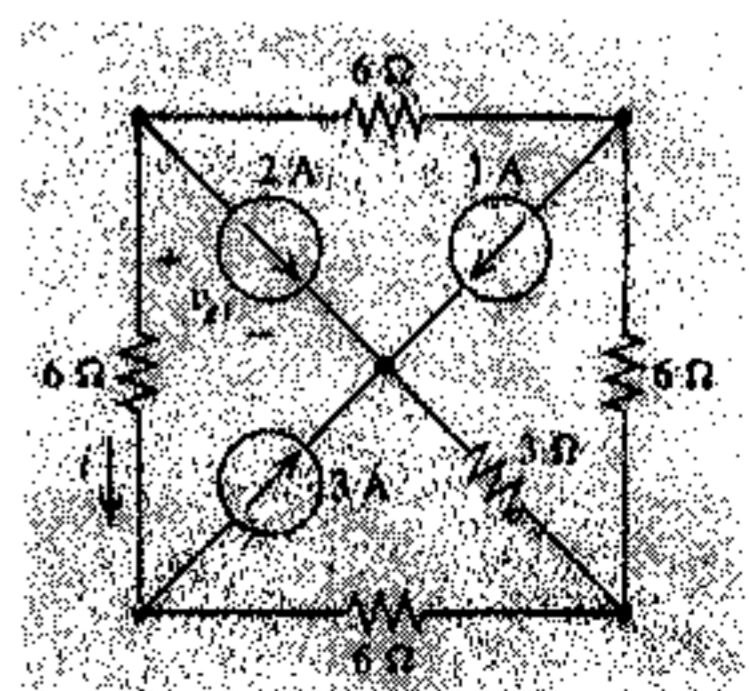
(A) 0　(B) 10　(C) $5(30)^{1/2}$　(D) $10(30)^{1/2}$　(E)15

32. Find k in the voltage transfer function v2=kv1

(A) –1　(B) –2　(C) 1　(D) 2　(E) 0
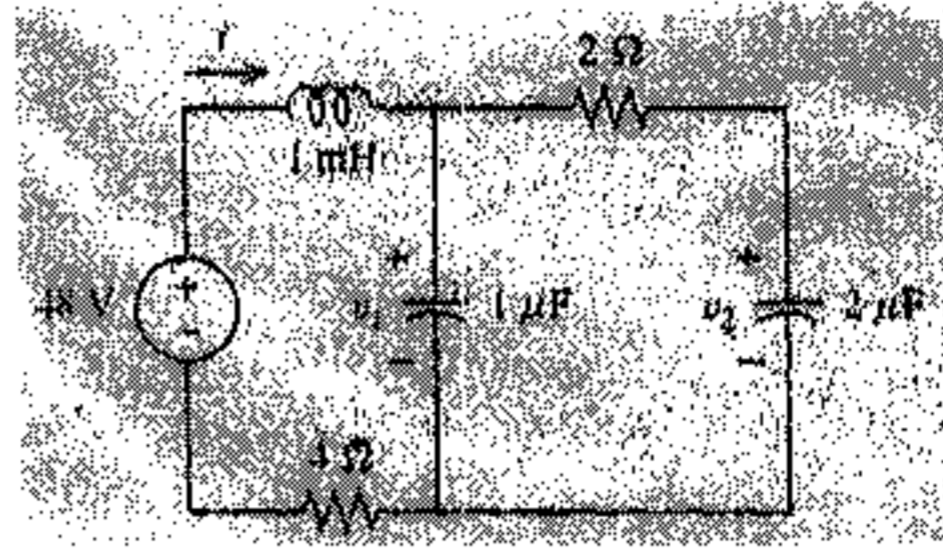

33. Use superposition to find v_{g1}(V).

(A) –42　(B) –20　(C) 0　(D) 20　(E) 42

單選題,以 2B 鉛筆劃在答案卡上;答對一題得 1 分,答錯一題倒扣 0.25 分,未答不計分。

34. Find V1(V) in dc steady state.
    (A) 0   (B) 12   (C) 24   (D) 48   (E) 96

35. Follow problem 34, Find V2(V) in dc steady state
    (A) 0   (B) 12   (C) 24   (D) 48   (E) 96

36. The circuit is in dc steady state at t=0−, find v(0−)= ? (V)
    (A) 18   (B) 12   (C) 6   (D) 3   (E) 0

37. Follow problem 36, find v(0+) =?(V)
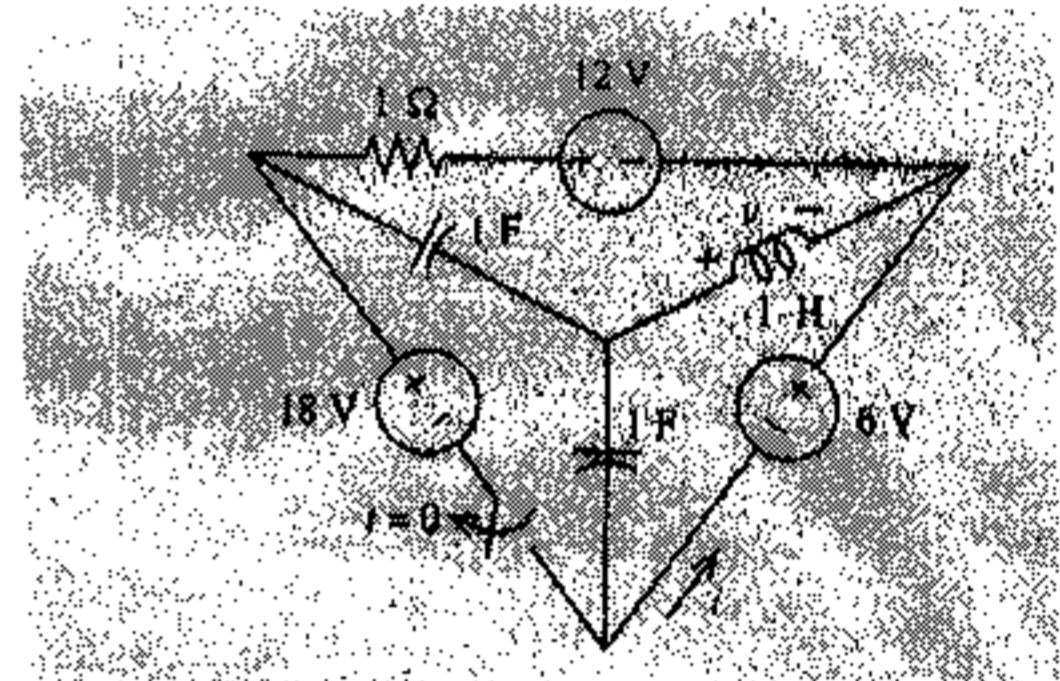   (A) 18   (B) 12   (C) 6   (D) 3   (E) 0

38. Follow problem 36, find i(0−) =?(A)
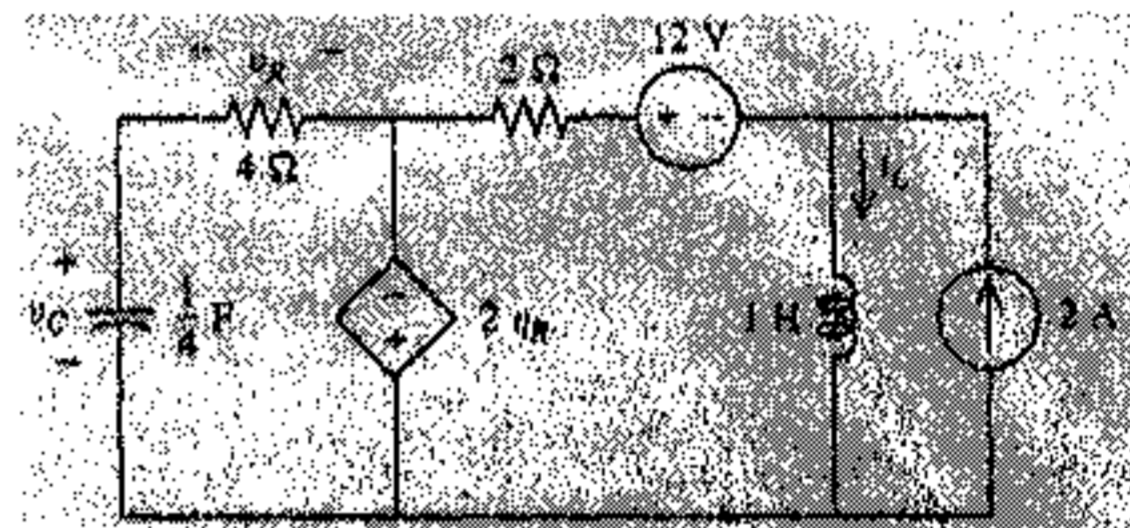   (A) 18   (B) 12   (C) 6   (D) 3   (E) 0

39. Follow problem 36, find i(0+) = ?(A)
    (A) 18   (B) 12   (C) 6   (D) 3   (E) 0

40. Find the total response $v_R(t)$ if $v_c(t)=0$ and $i_L(t)=1A$
    (A) 0   (B) 4V   (C) 8V   (D) 12V   (E) 16V

熱力學

41. A special catalyst is able to decompose water into hydrogen and oxygen completely at 30°C. How many liters of gas can be produced by decomposing 18 g ($\cong$25 liter) of water?
    (A) 25,   (B) 50,   (C) 62.5,   (D) 75,   (E) none of the above.

42. Indicate the wrong statement for the definition of isolated system in the following
    (A) no heat entering from outside (Q=0),   (B) no work done by the system (W=0),
    (C) no expansion or contraction of the system,   (D) no energy exchanged with the surroundings,
    (E) no energy interchanged in the system.

43. Indicate the wrong statement for the definition of closed system in the following   (A) heat can enter the system (Q≠0),   (B) work can be done by the system (W≠0),   (C) no mass enters or leaves the system, (D) the volume of the system is constant,   (E) energy can be interchanged in the system.

44. Please indicate the right statement for the 3rd law of thermodynamics: (A) the entropy of all perfect pure crystalline substances is zero,   (B) the entropy of each element in some perfect crystalline state is taken as zero,   (C) ΔS for any isothermal process is zero at 0°K,   (D) the internal energy of each element is taken as zero,   (E) none of the above.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

45. Indicate the wrong statement for the properties of ideal gas:　(A) no intermolecular interactions,
    (B) internal energy depends only on the temperature,　(C) internal energy does not depend on volume,
    (D) internal energy does not depend on pressure,
    (E) no heat needed in an isothermal reversible expansion process.

46. If X is a state function and $dX = \delta q_{rev}/T$, where δq_{rev} stands for reversibly adsorbed heat, calculate ΔX for
    the isothermal expansion of one mole of an ideal gas from 2 to 1 atm at 298K.　(A) $(1/2)R\ ln(1/2)$,
    (B) $R\ ln(2)$,　(C) 0,　(D) $2R\ ln(2)$,　(E) none of the above.

47. Indicate the wrong statement for the properties of the second law of thermodynamics:　(A) all reversible
    heat engines working in cycles between two temperatures, ΔT apart, must have the same efficiency,
    (B) $dS \geq 0$ in an isolated system,　(C) $(dA)_{T,V} \leq 0$,　(D) $(dG)_{T,P} \leq 0$,　(E) none of the above.

48. Indicate the wrong equation in the following:　(A) $(\partial G/\partial P)_T = V$,　(B) $(\partial G/\partial T)_P = (-S)$,
    (C) $(\partial S/\partial T)_P = (-C_p/T)$,　(D) $(\partial T/\partial P)_S = (\partial V/\partial S)_P$,　(E) $(\partial V/\partial T)_P = (-(\partial S/\partial P)_T)$.

49. What would be the maximum heat output for a 1 kW heat pump working between the temperatures of 12
    and 27°C?　(A) 20 kW,　(B) 1 kW,　(C) 0.05 kW,　(D) 15/27 kW,　(E) 12/27 kW.

50. The gas equilibrium of $2SO_2 + O_2 = 2SO_3$ at 1000K has a total pressure of 2 atm. It is known that only SO_3
    with a pressure of 1 atm exists initially. Please calculate the equilibrium constant at 1000K:
    (A) 2,　(B) 0.5,　(C) 2.5,　(D) 0.4,　(E) 1 atm^{-1}.

物理冶金

51. In a small-angle tilt boundary whose angle of tilt is 0.1°, and the Burgers vector of dislocations is 0.33 nm,
    which of the following value **is** the spacing between dislocations in the boundary?
    (A) 0.33 nm;　(B) 0.66 nm;　(C) 3.3 nm;　(D) 6.6 nm;　(E) 0.165 nm.

52. If a region with relatively higher atomic number than others, its image in SEM-BEI (backscattering electron
    image) **will be**:　(A) brighter;　(B) darker;　(C) more sharp;　(D) out of focus;　(E) no different with
    other regions.

53. It is observed that dislocations are easily generated inside the material A, but difficult produced in the
    material B, which is **true** in the following statements:
    (A) B is more ductile (large strain), because the material will be stronger if there is no dislocation;
    (B) Grain size of A is smaller than that of B, because there are many subgrains (dislocation cells);
    (C) A is more stronger than B, because there is the working hardening mechanism;
    (D) Deformation in A is greater than B, because dislocation could slip;
    (E) The dislocation has no effect on the elongation of material.

54. Which of the following phenomena is **the least** related to the interaction of a dislocation with solute atoms
    in a material?　(A) Dislocation atmosphere;　(B) Drag stress;　(C) Strain aging;　(D) Dynamic recovery;
    (E) Sharp yield point.

55. In the X-ray diffraction (XRD) experiment on two powder samples, one is nano-meter size and the other
    with mini-meter size, what would you find? (Every particle is considered as a crystal)
    (A) No difference between the X-ray results of nano and mini-meter samples;
    (B) Some peaks of nano-meter sample are disappeared;

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

(C) Some extra peaks of nano-meter sample are developed;

(D) The intensity of each peak of nano-meter sample is increased;

(E) The sharpness of each XRD peak of nano-meter sample is decreased.

56. Two-component system contains two phases in equilibrium condition, which of the following statements is **wrong**?

(A) T (temperature) keeps constant, the total content of alloy changes, the amount of each phase also changes;

(B) These two phases should have the identical partial-molal free energy;

(C) T keeps constant, the content of alloy changes, the equilibrium composition of each phase changes;

(D) For the same alloy, when the T changes, the equilibrium composition of each phase changes;

(E) The maximum number of equilibrium phases is 4 according to the phase rule.

57. Which one of the following five phenomena that could **not** strengthen the metal material?

(A) Working hardening;　(B) Dislocation cross-slip;　(C) Solid solution;　(D) Grain refining;

(E) Precipitation of second phase particle.

58. Which one of the following five statements is **wrong**:

(A) Vacancy is a kind of defect, if there is no vacancy inside a crystal, the total energy will decrease;

(B) Vacancy will assist the inter-diffusion of atoms;

(C) The raising of temperature, the equilibrium density of vacancy increases;

(D) If the metal quenched from high temperature, it has excess number of vacancy;

(E) The existence of vacancies inside a crystal decreases the total energy of material.

59. Identify the dislocation, in terms of its Brugers vector, that can **cross slip** between (111) and $(11\bar{1})$ planes of

an f.c.c. crystal.　(A) $1/3[1\bar{1}1]$;　(B) $1/2[\bar{1}10]$;　(C) [100];　(D) $1/6[\bar{1}\bar{1}0]$;　(E) none of above.

60. The recrystallization rate of a cold-worked metal is **not** dependent to which of the following parameters?

(A) Purity of the metal;　(B) Temperature of annealing;　(C) Time of annealing;

(D) Amount of deformation;　(E) The initial grain size before deformation.

近代物理

61. Let c be the light speed in vacuum. When c is expressed as a function of the electric permittivity ε_o and magnetic permeability μ_o, which of the following is correct

(A) $c = \varepsilon_o \mu_o$;　(B) $c = (\varepsilon_o \mu_o)^{-1}$;　(C) $c = \sqrt{\varepsilon_o \mu_o}$;　(D) $c = 1/\sqrt{\varepsilon_o \mu_o}$;　(E) $c = \varepsilon_o / \mu_o$.

62. Compton effect shows that　(A) electron has wavelike property.　(B) electron has particlelike property.

(C) light has wavelike property.　(D) light has particlelike property.

(E) both electron and light have wavelike property.

63. Gravitational red shift indicates that　(A) light has nonzero rest mass.　(B) light has nonzero momentum.

(C) electron mass is a constant.

(D) wave length of a cosmic radiation becomes longer as the observer on earth views an outgoing radiation.

(E) the energy of a cosmic radiation is decreasing as the observer on earth views an outgoing radiation.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

64. A free electron has the wavelike property, its wavelength λ can be expressed in terms of its energy E as

    (A) $\lambda = 1.24/E$ in unit of Å. (B) $\lambda = 1.24/E$ in unit of cm. (C) $\lambda = 1.24/E$ in unit of um.

    (D) $\lambda = 1.24/E$ in unit of m. (E) none of above is right.

65. About the wavelike property of a free electron, which of the following statements is correct?

    (A) It does not have the exact mass. (B) Its frequency is linearly proportional to its total energy.

    (C) The absolute value of its wave amplitude is proportional to its energy.

    (D) The square of its wave amplitude is proportional to its frequency.

    (E) It emits light when it is confined in a box of fixed volume.

66. About the uncertainty principle, which of the following statements is correct?

    (A) $\Delta p \cdot \Delta E \geq \hbar$ (B) $\Delta p \cdot \Delta t \leq \hbar$ (C) $\Delta p \cdot \Delta x \leq \hbar$ (D) $\Delta x \cdot \Delta E \geq \hbar$ (E) $\Delta p \cdot \Delta x \geq \hbar$

67. The atomic spectra

    (A) confirm the atom model proposed by Rutherford.

    (B) suggest that electrons in an atom do not have the same mass.

    (C) show the energy quantization of electrons in an atom.

    (D) can be explained by treating electrons in an atom as particles.

    (E) are identical to all elements in the periodic table.

68. In the followings, which was not described in the Bohr's model of atom

    (A) angular momentum. (B) the radius of electron orbit. (C) the electron spin.

    (D) the energy level of electrons. (E) all mentioned were specified in the model.

69. To verify the quantization of electron energy in an atom, you can

    (A) detect the intensity attenuation of an incident white light on the gas sample.

    (B) detect the energy loss of an incident electron with constant energy.

    (C) heat the gas sample and see the emission spectrum.

    (D) do an x-ray diffraction.

    (E) measure the specific heat of the gas sample.

70. In quantum mechanics, which of the following expressions concerns the energy conservation of a particle

    (A) $\int_{-\infty}^{\infty} |\psi|^2 dV = 1$. (B) $E = \hbar\omega$. (C) $\langle E \rangle = \dfrac{\int_{-\infty}^{\infty} E |\psi|^2 dV}{\int_{-\infty}^{\infty} |\psi|^2 dV}$. (D) $E = \hbar\omega + \dfrac{\hbar^2 k^2}{2m}$.

    (E) $-\dfrac{\hbar^2}{2m} \dfrac{\partial^2 \psi}{\partial x^2} + V\psi = i\hbar \dfrac{\partial \psi}{\partial t}$.

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71. While the carbonyl stretching frequency for simple aldehydes, ketones, and carboxylic acids is about 1710 cm⁻¹, the carbonyl stretching frequency for esters is about:

    (A) 1700 cm⁻¹ (B) 1735 cm⁻¹ (C) 1800 cm⁻¹ (D) 1660 cm⁻¹ (E) none of the above.

72. What alkyllithium would react with acetic acid to form 2-butanone?

    (A) methyllithium (B) vinyllithium (C) ethyllithium (D) propyllithium (E) none of the above.

單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

73. Which of the following amines can be resolved into enantiomers?

　(A) trimethylamine　(B) 3-pentanamine　(C) 2-pentanamine　(D) dimethylammonium chloride
　(E) none of the above.

74. Which of the following is also known as a Schiff base?

　(A) an imine　(B) a cyanohydrin　(C) a hydrate　(D) sodium hydroxide　(E) none of the above.

75. In electrophilic aromatic substitution reactions a chlorine substituent:

　(A) is a deactivator and a *m*-director.　(B) is a deactivator and an *o,p*-director.　(C) is an activator and a
　m-director.　(D) is an activator and an *o,p*-director.　(E) none of the above.

76. Which of the following is not a fused-ring heterocycle?

　(A) purine　(B) pyrimidine　(C) benzofuran　(D) indole　(E) none of the above.

77. Which of the following compounds is the most reactive dienophile in a Diels-Alder reaction with
　1,3-butadiene?　(A) $CH_2=CHOCH_3$　(B) $CH_2=CHCHO$　(C) $CH_3CH=CHCH_3$　(D) $(CH_3)_2C=CH_2$
　(E) none of the above.

78. To a solution of propyne in diethyl ether, one molar equivalent of CH_3Li was added and the resulting
　mixture was stirred for 0.5 hour.　After this time, an excess of D_2O was added.　Describe the major
　organic product(s) of this reaction.

　(A) CH_3CCD and CH_4　(B) CH_3CCCH_3　(C) CD_3CCCD_3　(D) CH_3CCCD_3　(E) none of the above.

79. When *trans*-3-hexene is treated with MCPBA, the major organic product is:

　(A) a meso epoxide　(B) a 1:1 mixture of enantiomeric epoxides　(C) a meso diol
　(D) a 1:1 mixture of enantiomeric diols　(E) none of the above.

80. When (*R*)-2-butanol is treated with TsCl in pyridine, the product formed is:

　(A) an achial compound.　(B) a mixture of diastereomers.　(C) a racemic mixture.
　(D) a single enantiomer.　(E) none of the above.

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Member *ABC* is supported by a pin and bracket at *B* and by an inextensible cord attached at *A* and *C* and
passing over a frictionless pulley at D as shown in figure
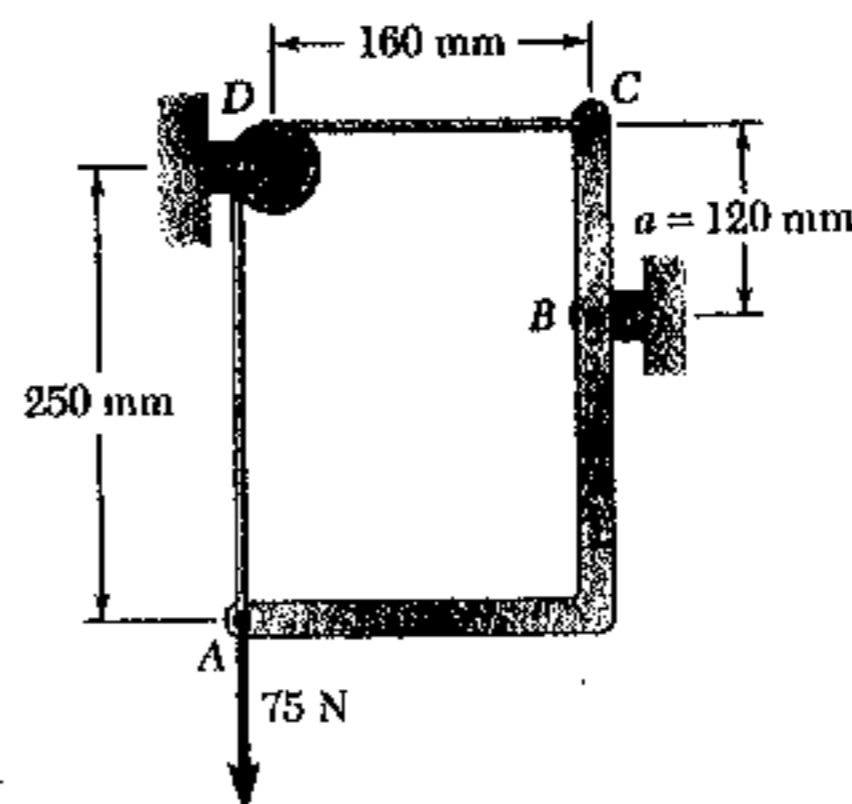
81. the tension force in cable is

　(A) 250 N　(B) 275 N　(C) 300 N
　(D) 325 N　(E) 350 N

82. the horizontal reaction at *B* is

　(A) 250 N　(B) 275 N　(C) 300 N
　(D) 325 N　(E) 350 N

83. the vertical reaction at *B* is

　(A) 200 N　(B) 225 N　(C) 250 N
　(D) 275 N　(E) 300 N

160 mm
D　　C
a = 120 mm
B
250 mm
A
75 N

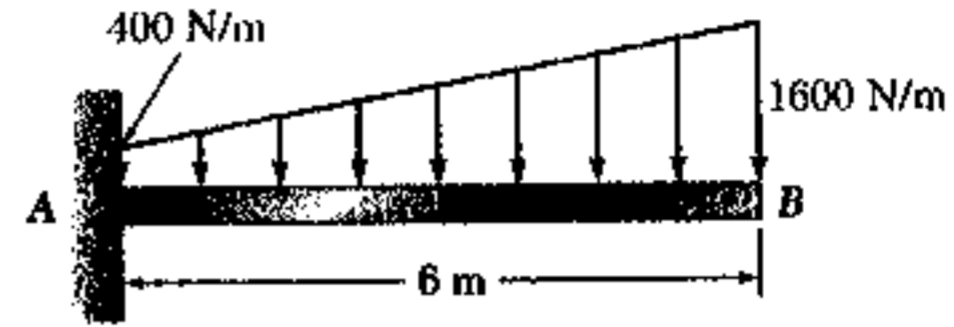單選題，以 2B 鉛筆劃在答案卡上；答對一題得 1 分，答錯一題倒扣 0.25 分，未答不計分。

For the beam and loading shown in figure

84. the vertical reaction at A is

    (A) 5 kN   (B) 5.25 kN   (C) 5.5 kN

    (D) 5.75 kN   (E) 6 kN

85. the reaction moment at A is

    (A) 21.6 kN-m   (B) 22.4 kN-m   (C) 23.2 kN-m

    (D) 24 kN-m   (E) 24.8 kN-m

For the truss and loading shown in the figure
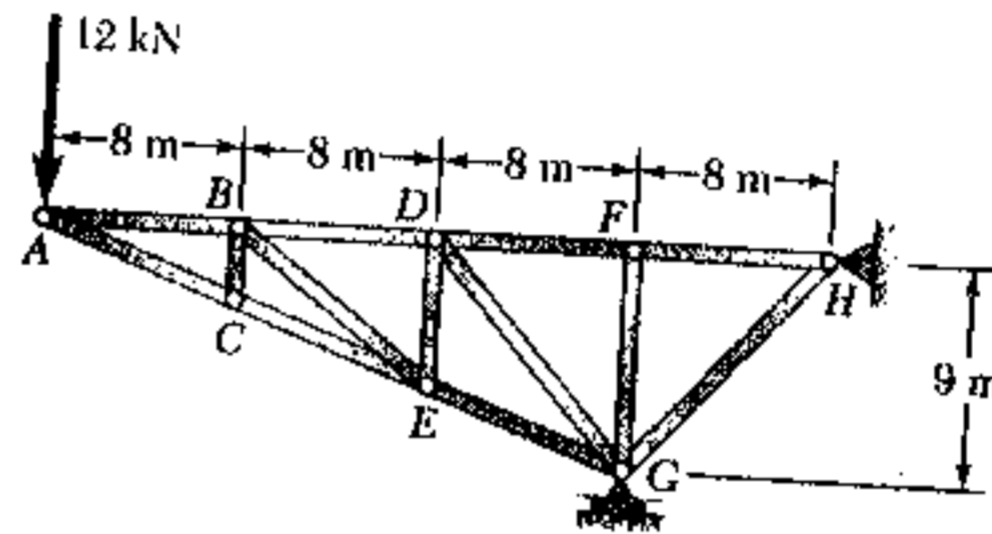
86. the zero force members in the truss are

    (A) 4 (B) 5 (C) 6 (D) 7 (E) 8

87. the force in member BD is

    (A) 24 kN   (B) 26 kN   (C) 28 kN

    (D) 30 kN (E) 32 kN

88. the reaction at roller G is

    (A) 40 kN   (B) 44 kN   (C) 48 kN

    (D) 52 kN   (E) 56 kN

A 24-ft-long steel tube with modulus of elasticity $E = 29 (10^3)$ ksi having the outer radius and inner radius of 3 in and 2 in, respectively. The tube is to be used as a pin-ended column. (89-90)

89. What is the maximum allowable axial load the column can support so that it does not buckle?

    (A) ~176 kip, (B) ~163 kip, (C) ~125 kip, (D) ~133 kip, (E) ~203 kip

90. The force created an average compressive stress at the maximum alloable axial load in the column is

    (A) ~11.20 ksi, (B) ~10.40 ksi, (C) ~7.98 ksi, (D) ~8.46 ksi, (E) ~12.95 ksi