注意：考試開始鈴響前，不可以翻閱試題

台灣聯合大學系統107學年度學士班轉學考試題

考試科目：普通物理

參考用

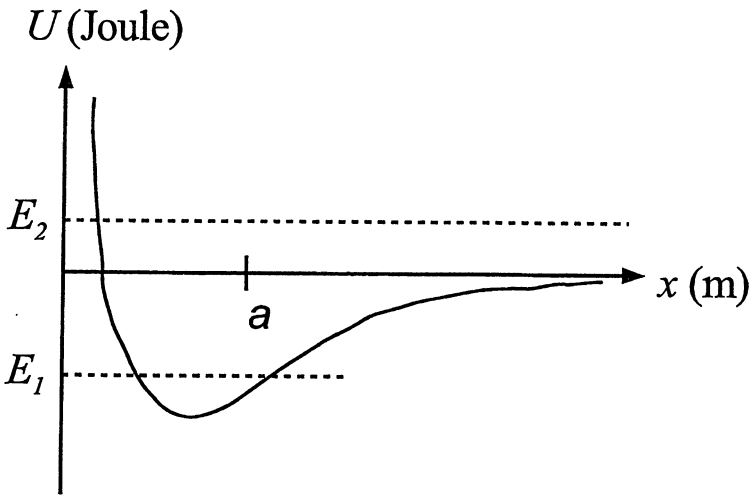
組別：A3、A6、A7

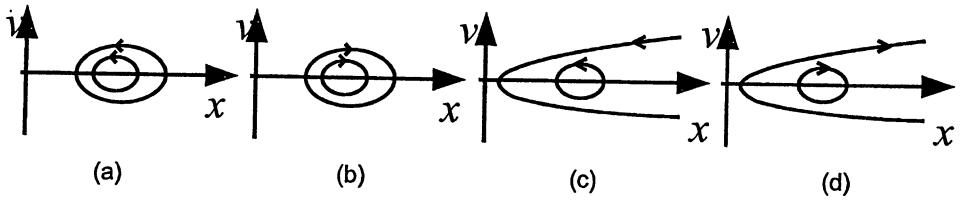
—作答注意事項—

1. 作答中如發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
2. 請核對答案卷（卡）上之准考證號、考試科目是否正確。
3. 本考科禁止使用計算器。
4. 選擇題請在答案卡上作答。
5. **考生限在作答區內作答，不可書寫姓名、准考證號或與作答無關之其他文字或符號。**
6. 答案卷用盡不得要求增加。
7. 答案卷限用藍筆或黑色鋼筆、原子筆或鉛筆書寫；答案卡限用2B軟心鉛筆畫記，如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果考生自行負責。
8. 因字跡潦草或作答未標明題號等情事，致評閱人員無法辨識答案者，該部分不予計分。

20 problems, 5 point each, there is only one correct answer in each problem

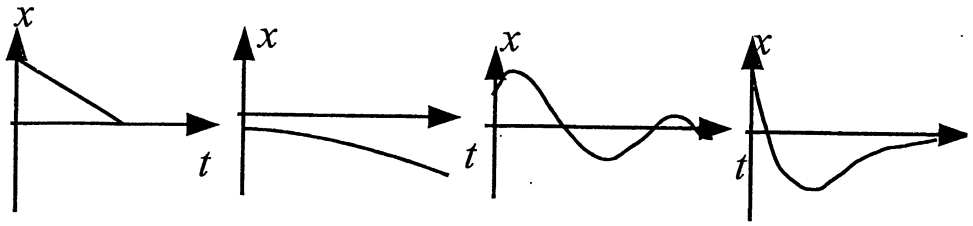
1. Consider a one-dimensional system with potential energy plotted below.
Which $x-v$ diagram correctly describes a particle with energy E_1 and another particle with energy E_2?





(e) none of the above

2. A mass m is attached to a spring with spring constant k (the other end of the spring is fixed). The mass of the spring is negligible. When the mass moves at velocity v, there is a drag force $-bv$ acting on the mass.
Which figure describes the displacement x of the mass as a function of time for some initial condition under the condition that the oscillator is overdamped?



(e) none of the above

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3. Consider an extra external force $F_{ext} = F_0 \cos \omega t$ acting on the mass of a damped oscillator. The phenomenon "resonance" can be seen by varying ω on what kind of oscillator?
(a) underdamped, (b) overdamped, (c) both kinds, (d) neither kind,
(e) resonance cannot be observed by varying ω.

4. Consider a small segment of a string which is under tension T. The mass density of the string is λ and the length of this segment is dx. Let the vertical displacement of the string be $y(x,t)$ and $\partial y/\partial x$ be small everywhere. The vertical force acting on this segment is
(a) $\lambda dx(\partial^2 y/\partial x^2)$, (b) $\lambda dx(\partial y/\partial t)$, (c) $Tdx(\partial^2 y/\partial t^2)$, (d) $Tdx(\partial^2 y/\partial x^2)$,
(e) none of the above.

參考用

5. Which expression cannot represent a solution of the wave equation?
(a) $A\sin(kx-\omega t)$, (b) $A\sin^2(kx-\omega t)$, (c) $A[\ln(kx)-\ln(\omega t)]$, (d) $A/[2+\sin(kx-\omega t)]$,
(e) all expressions can represent a solution of the wave equation.

6. The key concepts behind Kepler's 2nd law for planetary motion (the line joining the sun to a planet sweeps out equal areas in equal times) include
(a) energy conservation, (b) momentum conservation, (c) angular momentum conservation,
(d) both (a)(b), (e) both (a)(c).

7. A rocket has a mass of 2×10^6 kg. It expels gas at the rate of 2×10^4 kg/s with an exhaust speed of 1000 m/s relative to the rocket. The initial acceleration of the rocket at the launch pad (neglect gravity) is closest to
(a) 1 m/s^2, (b) 10 m/s^2, (c) 100 m/s^2, (d) 1000 m/s^2, (e) 100000 m/s^2.

8. Water (mass density ρ) flows at speed v_i through a garden hose with cross sectional area a_0 and emerges at pressure p_f from a nozzle of cross sectional area $a_0/2$. The pressure at the faucet is
(a) $3\rho v_i^2/2+p_f$, (b) $\rho v_i^2/2+p_f$, (c) $-3\rho v_i^2/2+p_f$, (d) $-\rho v_i^2/2+p_f$,
(e) none of the above.

9. Consider N gas molecules in a cubic box of lateral size L at temperature T. Neglect the interactions between the particles and let m be the mass of a molecule, the average number of particles hitting one of the bounding walls per unit time is (k_B is the Boltzmann constant)
(a) $\sqrt{4Nk_BT/3mL^2}$, (b) $\sqrt{4N^2k_BT/(3mL^2)}$, (c) $\sqrt{N^2k_BT/mL^2}$, (d) $\sqrt{Nk_BT/mL^2}$,
(e) none of the above.

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10. N is the number of particles in the system, V is the volume of the system, T is the temperature of the system. Which of the following is a possible expression of the entropy of a macroscopic system?

(a) $N\ln(N/V)$, (b) Nk_BT, (c) Nk_BT/V, (d) $N\ln V+N$,

(e) none of the above.

11. Which quantity changes during the free expansion of an ideal gas?

(a) energy, (b) entropy, (c) temperature, (d) above all,

(e) none of the above.

12. When an external electric field is applied to a dielectric,

(a) the electric dipoles align antiparallel to the external field, the electric field in the interior becomes smaller than external electric field,

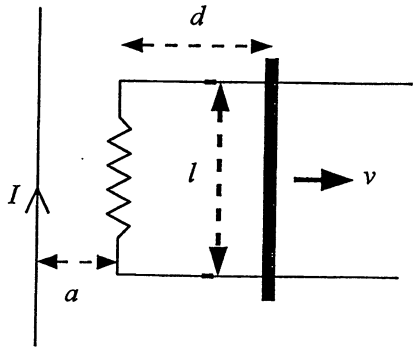
(b) the electric dipoles align parallel to the external field, the electric field in the interior becomes smaller than external electric field,

(c) the electric dipoles align antiparallel to the external field, the electric field in the interior becomes greater than external electric field,

(d) the electric dipoles align parallel to the external field, the electric field in the interior becomes greater than external electric field,

(e) none of the above.

13. A long, straight wire carries a constant current I. A metal rod of length l moves at constant velocity on rails of negliglble resistance that terminate in a resistor R, as shown in the figure. The induced current in the resistor is



(a) $\mu_0 Ivl/[2\pi(a+d)R]$, (b) $\mu_0 Ivl/[2\pi dR]$, (c) $\mu_0 Iv(a+d)/[2\pi lR]$, (d) $\mu_0 Iv(a+d)l/[2\pi R]$,

(e) none of the above.

14. A solenoid with N turns has a length l and a radius r. For what current will the energy density within the solenoid be u?

(a) $\sqrt{2u/\mu_0 N}$, (b) $\sqrt{2ul/\mu_0 N}$, (c) $\sqrt{2u^2l/\mu_0 N^2}$, (d) $\sqrt{2ul^2/\mu_0 N^2}$, (e) none of the above.

15. Consider refraction of a wave, what changes as wave enters from medium I to medium II with different index of refraction? (i) wavelength changes (ii) frequency changes (iii) amplitude changes (iv) wave speed changes
(a) (i) (iii), (b) (i)(iii) (iv), (c) (ii) (iv), (d) (ii)(iii)(iv), (e) none of the above.

16. In a double-slit experiment the slits are 0.5 mm wide and their centers are separated by 1.5 mm. The interference maxima of what order are missing?
(a) $m = 2$, (b) $m = 4$, (c) $m = 6$, (d) all above, (e) none of the above.

17. Light strikes a plate in an evacuated chamber. The result is that electrons are emitted from the plate P and are collected by C. In the process a single photon gives up all its energy to a single electron. The maximum possible kinetic energy of the photoelectrons, $\frac{1}{2}mv_{max}^2$, is related to the energy of a photon, hf, by (ϕ is work function)
(a) $hf = \frac{\phi}{2}mv_{max}^2$, (b) $hf = \frac{1}{2\phi}mv_{max}^2$, (c) $hf = \frac{1}{2}mv_{max}^2 + \phi$, (d) $hf = \frac{1}{2}mv_{max}^2$,
(e) none of the above.

18. Which of the following has the correct dimension of a bulk modulus?
(a) Pa, (b) Pa /s, (c) N/m^3, (d) kg/m^3, (e) none of the above.

19. How does the intensity of radiation changes with the distance r from the source? Let d be the spatial dimension.
(a) proportional to r^{-d}, (b) proportional to r^{-d-1}, (c) proportional to r^{-d+1},
(d) proportional to r^{-2}, (e) none of the above.

20. Here is a simple way to estimate the ground-state energy for a particle in a potential k/r. Suppose the ground state momentum and position satisfies Heisenberg's uncertainty principle $pr \sim \hbar$, the kinetic energy in the ground state is Minimize the total energy of the system you find that ground state energy is roughly
(a) $-km/2\hbar^2$, (b) $km/2\hbar^2$, (c) $-k^2m/2\hbar^2$, (d) $-k^2\hbar^2m$, (e) none of the above