

2014 年全國華文獨中數理學識比賽 – 物理

适用的常數表 List of useful constants

光速 Speed of light: $c = 3 \times 10^8$ m/s

普朗克常數 Plank constant: $h = 6.626 \times 10^{-34}$ Js

重力加速度 Gravitational acceleration on earth: $g = 10$ m/s²

水的比熱 Specific heat of water: $c_{\text{water}} = 4180$ J/kg.K

声波在空气中的速度 Speed of sound in air = 343 m/s

(1) 在地面把球以初速 100m/s 垂直往上拋，三秒以後球的速度為：

A ball is thrown up vertically from the ground with initial speed 100m/s. What is its velocity 3 seconds later .

- (a) 20 m/s downward (往下) (b) 36 m/s upward (往上)
(c) 70 m/s upward (往上) (d) 70 m/s downward (往下)
(e) None of the above. (以上皆非)

(2) 一個靜止的紅球被速度為 12m/s 白球碰撞，如果兩個球的質量一樣，而且它們在直線上運動，則碰撞以後紅球的速率為（假设能量守恒）：

A red ball at rest is collided by a white ball moving with speed 12m/s. Assuming the balls have the same mass and can only move on a straight line then what is the speed of the red ball after collision (assume conservation of energy):

- (a) 0 (b) 3 m/s (c) 6 m/s (d) 12 m/s (e) None of the above.

(3) 單擺的週期 T 為（設 l 是擺長， g 為重力加速度， m 為質量）：

The period T of a pendulum is given by the following formulae (l is the length, g is the gravity acceleration and m is the mass):

- (a) mg/l (b) $\sqrt{\frac{g}{l}}$ (c) $\frac{1}{2\pi} \sqrt{\frac{l}{g}}$ (d) $2\pi \sqrt{\frac{m}{g}}$ (e) $2\pi \sqrt{\frac{g}{l}}$.

(4) 某物體其質量為 $m = 5$ kg，在不平滑的表面上滑動（動摩擦係數 $\mu = 0.1$ ）。如果物體的初速為 25m/s，而且有一個定力 5 N 作用其上，則 1 秒後物體移動的距離為：

A block of mass $m = 5$ kg is moving on a rough surface with kinetic friction coefficient $\mu = 0.1$. If the block moves with initial speed 25m/s and there is a constant force 5 N acting on it. The distance it travels after 1 second is:

- (a) 25 m (b) 20 m (c) 13 m (d) 23 m (e) 18 m.

(5) 靜止的球從高度 10 公尺往地面掉下，如果每次球從地面彈起都損耗 10% 的能量，則第二次從地面彈起，離地面之最高距離為：

A ball at rest falls at 10 m above ground. Suppose that the ball bounces up by losing 10% of its energy. Then what is its highest height after the second bouncing:

- (a) 9 m (b) 9.2 m (c) 7.4 m (d) 8.1 m (e) None of the above.

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(6) 質量為 m 的流星離地球之距離為 R ，則他的動位能為（ G 為萬有引力常數， M 為地球質量）：
A comet of mass m is a distance R away from the earth then its gravitational potential energy is (G is the Newton Constant and M is the mass of the earth):

- (a) mgR (b) GMm/R^3 (c) $-Gm/R^2$ (d) $-GMm/R^3$ (e) $-GMm/R$.

(7) 質量 m 的物體受彈簧拉力做運動，如果它的總能量為 $\frac{1}{2}kx_m^2$ （ k 為彈簧的力常數， x_m 為物體離開平衡點的最大位移）則最大速度的位置會出現在：

The total energy of a mass m connected to a spring with spring constant k is $\frac{1}{2}kx_m^2$, where x_m is the maximum displacement of the mass from its equilibrium position. Then the position for the maximum speed is located at:

- (a) x_m (b) $x_m/2$ (c) $x_m/4$ (d) 0 (e) None of the above.

(8) 等速圓周運動的向心加速度 a_c 正比於：

For uniform circular motion the centripetal acceleration a_c is proportional to

- (a) Tangential speed v (b) Radius R (c) R^2 (d) v^2 (e) $1/R^2$.

(9) 行星對太陽做圓週運動，如果 K 代表它的動能， E 為總能量，則以下哪一個敘述為正確：

For circular planetary motion around the sun, if the kinetic energy is denoted by K and the total energy is E then which of the following statement is correct :

- (a) $E = 2K$ (b) $E = -2K$ (c) $E = -K$ (d) $E = -K/2$ (e) None of the above.

(10) 質量為 m ，電荷為 Q 的粒子在均勻電場 $\vec{E} = E\hat{x}$ 中運動，如果 $t=0$ 的初速為 $\vec{v}_0 = v_0\hat{y}$ ，則 T 秒後它的動量 \vec{P} 為：

A particle of charge Q and mass m is moving in the uniform electric field $\vec{E} = E\hat{x}$. If at $t=0$ the initial velocity is $\vec{v}_0 = v_0\hat{y}$ then the momentum \vec{P} of the particle at later time T is:

- (a) $m(\vec{v}_0 + \vec{E})$ (b) $m\vec{v}_0 + Q\vec{E}$ (c) $m(\vec{v}_0 + Q\vec{E}T)$ (d) $m\vec{v}_0 + QT\vec{E}$ (e) $mQT\vec{E}$.

(11) 以電功率為 1kW 的電熱器加熱一公升的水，當開始的水溫為 $T = 25^\circ\text{C}$ ，則 41.8 秒後的水溫為：

One liter of water is heating by the electric heater of power 1kW. If the heating process begins at water temperature $T = 25^\circ\text{C}$, what is the water temperature after heating for 41.8 sec?

- (a) 35°C (b) 45°C (c) 30°C (d) 50°C (e) 60°C .

(12) 22.4 公升的氧氣從 25°C 加熱到 50°C 時它的壓力為：

22.4 liters of oxygen at 25°C is heated to 50°C . Its final pressure is:

- (a) 2.4 atm (b) 3.4 atm (c) 5.4 atm (d) 6.7 atm (e) None of the above.

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(13) 靜止的救護車的警笛頻率為 ω_0 ，如果它以 50km/hr 往醫院疾駛，則對醫院門口的醫生而言，他所聽到的頻率：

The siren of the ambulance car at rest is ω_0 . If it is now traveling at a speed 50km/hr and approaching to the hospital, then for the doctor waiting at the gate of the hospital the frequency appealed to him is:

- (a) Higher than ω_0 (比 ω_0 高)
- (b) Lower than ω_0 (比 ω_0 低)
- (c) The same as ω_0 (等於 ω_0)
- (d) $= 2\omega_0$
- (e) $= \omega_0/2$

(14) 對電力線而言，下列敘述何者為正確：

Which of the statement is true for the electric field lines:

- (a) They are closed loops (它們是封閉曲線)
- (b) They do not cross each other (它們不會相交)
- (c) They are always perpendicular to the magnetic field (它們永遠與磁力線垂直)
- (d) They are always parallel to one another (它們都相互平行)
- (e) They can cross each other. (它們會相交)

(15) 兩個距離為 D 的電荷，他們的電性相反而大小相等，則距離兩電荷連線中點為 R 的任何點上，如果 $R \gg D$ ，則在該點上的電場正比於：

Two charges of equal magnitude but opposite sign have a distance D between them. For a point with distance R measured from the midpoint of these charges, if $R \gg D$ then at this point the electric field is proportional to:

- (a) $\frac{1}{R^2}$
- (b) $1/RD$
- (c) $1/(R-D)$
- (d) $\frac{1}{R^3}$
- (e) $\frac{1}{(R-D)^3}$.

(16) 電荷 Q 在距離 R 上一點所產生的電位正比於：

The electric potential of charges Q is proportion to (where R is the distance measured from Q) :

- (a) Q^2
- (b) $Q^{1/2}$
- (c) Q^2/R
- (d) Q/R
- (e) $1/R^2$.

(17) 電熱器的電阻為 50 Ω ，如果加在它的電壓為 200V，則電熱器所提供的功率為：

A electric heater has resistance of 50 Ω . If it is operated at 200V what is the power of the heater:

- (a) 80W
- (b) 40W
- (c) 400W
- (d) 800W
- (e) 450W.

(18) 兩個電阻並聯在一起，並且連結到一個 24V 的電池，如果電阻為 $R_1 = 4\Omega$ 和 $R_2 = 8\Omega$ ，則以下哪一個敘述是錯的：

Two resistors connected in parallel are connected to a battery of 24V. If the resistance s are $R_1 = 4\Omega$ and $R_2 = 8\Omega$, then which of the following statement is incorrect:

- (a) R_1 dissipates more power (R_1 消耗的功率比較大)
- (b) R_1 has a larger current (R_1 中的電流比較大)
- (c) They dissipate the same power (它們的功率一樣)
- (d) The total current is 8.9A (總電流為 8.9A)
- (e) The total resistance is 2.67 Ω . (總電阻為 2.67 Ω)

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(19) 電荷 $q = 3\text{ C}$ ，其速度為 $\vec{v} = 10\hat{x}\text{ (m/s)}$ ，在電場 $\vec{E} = 3\hat{y}\text{ (N/C)}$ 及磁場 $\vec{B} = 0.3\hat{z}\text{ (Tesla)}$ 中運動，則作用在 q 上的總力為：

A particle with charge $q = 3\text{ C}$ has velocity $\vec{v} = 10\hat{x}\text{ (m/s)}$ and is moving in a region with electric field $\vec{E} = 3\hat{y}\text{ (N/C)}$ and magnetic field $\vec{B} = 0.3\hat{z}\text{ (Tesla)}$. The total force acting on this charge is:

- (a) $6\hat{z}\text{ (N)}$ (b) $-6\hat{z}\text{ (N)}$ (c) 0 (d) 9 (N) (e) None of the above.

(20) 對無窮長的直線電流 I ，他在距離 R 上所產生的磁場正比於：

For infinite long straight current, the magnetic field that it generates at a distance R away from it is proportional to:

- (a) R (b) R^{-2} (c) R^{-1} (d) I^2 (e) $1/I$.

(21) 對任何溫度下的物體而言，其表面所發射的能量正比於：

For any object with temperature T the amount of energy that radiates from its surface is proportional to

- (a) T (b) T^2 (c) T^3 (d) T^4 (e) \sqrt{T} .

(22) 愛因斯坦提出光子的觀念來解釋光電效應，對 1 mW 的紅色雷射筆而言，（波長為 700 nm ），每秒大概發射多少個光子？

Einstein introduced the concept of photon to describe the photoelectric effect. For a 1 mW Laser pointer of red color (with a wavelength = 700 nm), how many photon are approximately emitted in one second?

- (a) 1000 (b) 6.2×10^6 (c) 2.6×10^{23} (d) 3.5×10^{15} (e) 2.3×10^{13} .

(23) 原子與原子核的大小約為：

What are the approximate sizes of atom and nucleus respectively:

- (a) 10 nm , 10 fm (b) 10 nm , 100 nm (c) 10 nm , 100 fm
(d) 10 fm , 1 fm (e) None of the above.

(24) 光可以被物體反射、吸收及繞射，或在物質中傳送，以下的現象哪一個與繞射有關？

Light can be reflected, transmitted, absorbed and diffracted by objects. Which of the following situations is due to light diffraction:

- (a) Rainbow (彩虹)
(b) The resolution of a microscope (顯微鏡的鑑別率)
(c) Cooking in microwave oven (在微波爐中加熱)
(d) Light traveling in the optical fiber (在光纖中傳送光)
(e) None of the above.

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(25) 以下哪一個不是波的正确敘述 (A, f, λ 和 I 分別為波的振幅、頻率、波長、強度)

Which of the following statements is not correct for describing wave (where A, f, λ and I are the amplitude, frequency, wavelength and intensity respectively) :

(a) $I \propto A^2$

(b) Wave speed = λf (波速 = λf)

(c) Waves cannot be added as another wave (波的疊加不是波)

(d) Depending on the frequency wave can move with different speed in the same medium (在相同介質中波速與頻率有關)

(e) Waves can carry energy. (波帶有能量)