第 25 届全国华文独中数理学识比赛 (2008)
物理学科

计算时如有必要，可利用下列数值
Please use the following constants for your calculation if necessary

Earth gravitational acceleration 地球表面的重力加速度 $g=9.8\ m/s^2$
Speed of light in vacuum 真空光速 $c=3.0\times10^8\ m/s$
Electron charge 电子电荷 $e=1.6\times10^{-19}\ C$
Planck's constant 普朗克常数 $h=6.3\times10^{-34}\ J\text{-}s$

1. 车子突然刹车，坐在车内的人会感受到一个往前推的力量，但是我们认为这个力量不是一个真正力量，是根据

   The man in the bus felt a force pushing him forward when the bus suddenly stopped, but we didn't regard this force really a force, according to

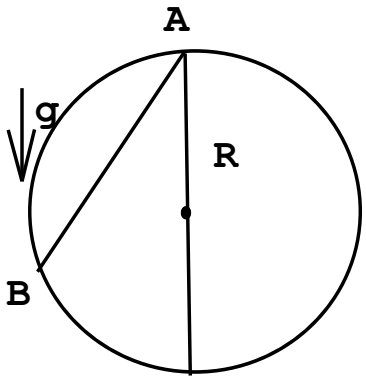
   (A) 牛顿第一定律 Newton's 1st law of motion
   (B) 牛顿第二定律 Newton's 2nd law of motion
   (C) 牛顿第三定律 Newton's 3rd law of motion
   (D) 能量守恒定律 Conservation of energy
   (E) 动量守恒定律 Conservation of momentum

2. 一质量 50 公斤的人在电梯中量体重，测得其重量为 60 公斤重，则电梯的加速度为?

   A man of mass 50 kg in an elevator measures his weight as 60 kg. The acceleration of the elevator is:

   (A) 0.1g，向上 0.1g, upward
   (B) 0.1g，向下 0.1g, downward
   (C) 0.2g，向上 0.2g, upward
   (D) 0.2g，向下 0.2g, downward
   (E) 以上皆非 none of the above

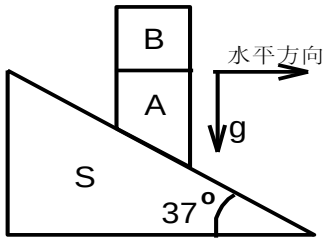
3. 有一小球，受到重力作用，从一铅垂圆的顶点 A 由静止开始沿着任意弦 $\overline{AB}$ 往下运动，下列叙述何者正确？



A bead starts from rest at the top of the Vertical circle A and slides down under the influence of gravity along any smooth chord $\overline{AB}$. Which of the following statements is correct?

(A) 该小球沿着弦 $\overline{AB}$ 的加速度和 B 点的位置无关 the acceleration of the bead along $\overline{AB}$ is independent of the point B.
(B) 该小球到达 B 点的速率和 B 点的位置无关 the speed of the bead when it reaches the point B is independent of the position of B.
(C) 该小球到达 B 点的时间和 B 的位置无关 the time takes for the bead to reach the point B is independent of the position of B.
(D) 在运动的过程中，重力对该小球所做的功和 B 点的位置无关 the work done by the gravity is independent of the position of B.
(E) 以上皆非 none of the above

4. 如图有一固定的斜面S，其斜角为37°，在斜面上置有一物体A，且在A之上置有另一物体B。斜面S和物体A之间没有摩擦力，但是A,B两物体间有摩擦力。假设A物体往下运动的过程中，B物体都静止在A物体的上面，则A，B 两物体间的静摩擦数可能为：



A block A is moving down along a smooth fixed wedge S of angle 37°. On A there is another block B which has the same mass as block A, but there is friction between them. If the block B always rests on A while it is sliding down along the wedge, the coefficient of the static friction between A and B may be:

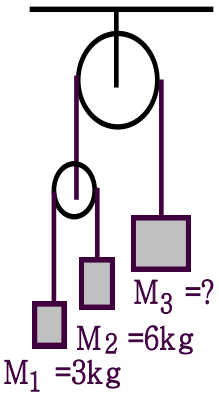
(A) 0.8　　(B) 0.7　　(C) 0.6
(D) 0.5　　(E) 以上皆非 None of the above

5. 一静止的物体突然爆炸成三块质量相同的小物体，三者速度大小的比值为 3:4:5，则此三物体爆炸飞出时其速度的夹角为

An object at rest exploded suddenly into 3 pieces of equal mass with the ratio of speed 3:4:5. The angles between the velocity are

(A) 90°, 120°, 150°　　(B) 90°, 135°, 135°
(C) 90°, 127°, 143°　　(D) 90°, 108°, 162°
(E) 以上皆非 None of the above

6. 如图所示的系统，两物体的质量分别为 $M_1 = 3\,kg, M_2 = 6\,kg$，已知质量 M_3 的物体永远静止。假设滑轮的质量不计，且所有的摩擦力皆可忽略，则 $M_3 =$



In the system shown in the figure, the mass of two blocks are $M_1 = 3\,kg, M_2 = 6\,kg$, and the block of mass M_3 is always at rest. If the mass of pulleys is negligible and there are no frictions between all contact surfaces, then $M_3 =$

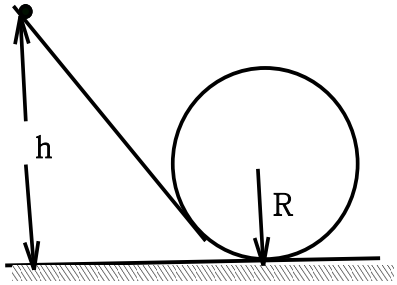
(A) 4 kg　　(B) 6 kg
(C) 8 kg　　(D) 10 kg
(E) 以上皆非 None of the above

7. 有一均匀，全长 ℓ 的绳子原先静止於一无摩擦力的桌面上，且有 2/3 的绳子在桌面上，其馀在桌边自然下垂。现假设此绳受到重力作用，由静止开始往下掉，则该绳子恰离开桌子时的速率为?

Two thirds of a uniform rope of length ℓ rests on a smooth table, and the rest part hangs over the side the table. Suppose the rope moves down from rest under the gravity. What is the speed of the rope at instant when it just slides off the table?

(A) $\frac{2}{3}\sqrt{2g\ell}$　　(B) $\frac{3}{4}\sqrt{2g\ell}$　　(C) $2\sqrt{2g\ell}$
(D) $3\sqrt{2g\ell}$　　(E) 以上皆非 None of the above

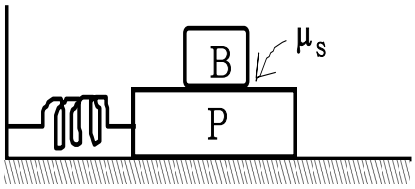
8. 如右图中，有一物体从高度 h 处，由静止沿着一直线轨道射入一半径为 R 的光滑圆形轨道，若该物体能够完整的绕完一圈，则 h 最小值为何？



An object slides down from rest along a loop-the-loop track with radius R. What is the minimum height h of the starting point in order to make a complete turn?

(A)1.5 R　(B) 2.0 R　(C) 2.5 R　(D) 3.0 R　(E) 以上皆非 None of the above

9. 有一大的物体 P 在一水平的光滑面上作简谐运动，其运动的频率为 f =1.5 Hz。有一物体 B 在 P 之上，两者间的静摩擦系数为 $\mu_s = 0.6$。假设在运动的过程中，物体 B 皆静止於 P 上，则运动的最大振幅为何？



A large block P executes horizontal SHM motion on a smooth surface with frequency f =1.5 Hz. Block B rests on P, and the coefficient of static friction between the two is $\mu_s = 0.6$. What maximum amplitude of oscillation can the system have if block B always remains rest on P?

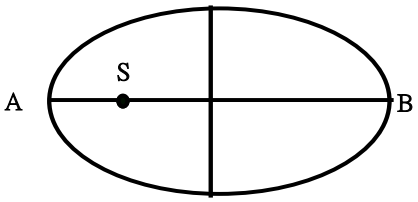
(A) 3.31cm　(B) 4.50 cm　(C) 6.62 cm
(D) 9.96 cm　(E) 以上皆非 None of the above

10. 两人 A,B 同时握住一均匀水平木棍的两端，此木棍重 W。有一人 B 突然松手，则在松手那一刹那，另一人 A 作用於木棍的力量为：

Two men A and B hold a uniform horizontal rod of weight W. What is the force acting on the rod by the man A at the instance when the man B releases his hold?

A)W　(B)W/2　(C)W/4　(D)W/6　(E) 以上皆非 None of the above

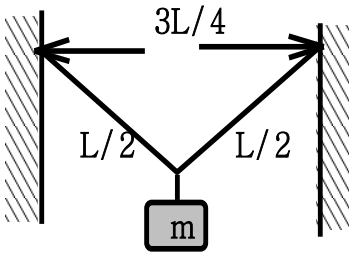
11. 行星以椭圆轨道绕太阳 S 运行，假设行星在近日点 A 的速率是在远日点 B 速率的 4 倍，则该行星轨道的离心率为



A planet moves around the sun S with an elliptic orbit. If its speed at the perihelion A is 4 times as at the aphelion B, what is the eccentricity of the planet?

(A) 0.2　　(B) 0.3
(C) 0.4　　(D) 0.5
(E) 0.6

12. 有一细绳，每单位长度的质量为λ，将此绳的两端系於相距 3/4 绳长的两固定壁上，现在绳子的中点悬挂一质量为 m 之物体，使绳子有一张力。现若有绳波在该绳上传递，则该绳波传递的速度为何？



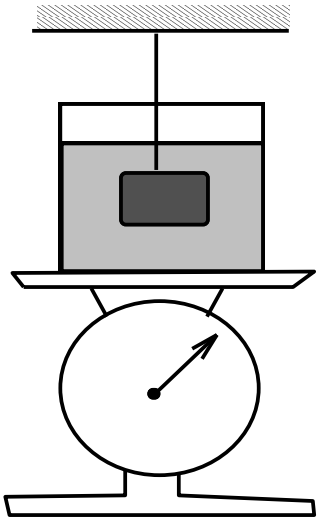
A light string of mass per unit length λ has its ends tied to two walls separated by a distance equal to 3/4 the length of the string. An object of mass m is suspended from the center of the string, putting a tension in the string. What is the speed of transverse wave in the string?

(A) $\sqrt{\frac{mg}{\lambda\sqrt{7}}}$　　(B) $\sqrt{\frac{2mg}{\lambda\sqrt{7}}}$

(C) $\sqrt{\frac{3mg}{\lambda\sqrt{7}}}$　　(D) $\sqrt{\frac{5mg}{\lambda\sqrt{7}}}$

(E) 以上皆非 None of the above

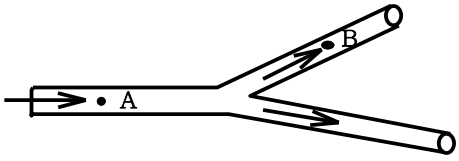
13. 有一质量 1.0kg 的烧杯装有 2.0 kg 的水(密度= 1. 0g/cm^3) 静止在一磅秤上，另有一质量为 2.0 kg 的物体悬挂於一绳子之下，且完全浸入於水面下。若枰之读数为 3.5kg，则该物体的质量密度为?



A 1.0 kg beaker containing 2.0 kg of water (density =1.0 g/cm^3) rests on a scale. A 2.0 kg block of mass is suspended from a string and is completely submerged in the water. If the reading of scale is 3.5 kg, what is the mass density of the block?

(A) 2.0 g/cm^3
(B) 3.0 g/cm^3
(C) 4.0 g/cm^3
(D) 5.0 g/cm^3
(E) 以上皆非 None of the above

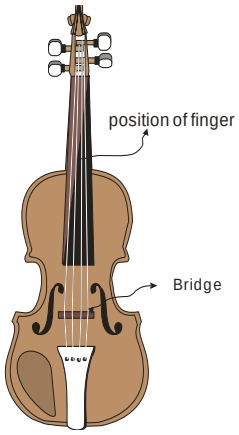
14. 有一水管，口径为 5.0 cm，在点 A 水的压强为 7.5×10^4 N/m^2，流速为 1.7 m/s。该水管分两小水管，口径各为 2.5 cm，则在点 B 水的压强为：(假设水管的高度为一定)



A water pipe has 5.0 cm in diameter, and at point A, the pressure of water flow is 7.5×10^4 N/m^2 and the speed of water flow is 1.7 m/s. The pipe splits into two small pipes, each of 2.5 cm in diameter. What is the pressure of the water at point B? Assume the pipe at constant height.

(A) 7.32×10^4 N/m^2
(B) 7.07×10^4 N/m^2
(C) 5.33×10^4 N/m^2
(D) 5.60×10^4 N/m^2
(E) 以上皆非 None of the above

15. 一小提琴的弦长 35 cm，且被调音发出频率 392 Hz 的声音，现有一提琴手要拉出频率 400 Hz 的声音，他的手指应压在弦的何处？



A violin sting has a length of 35 cm and is tuned to the frequency 392 Hz. Where must the violist place his finger to play a sound of frequency 400 Hz?

(A) 距弦桥 31.2cm 处 31.2cm from the bridge
(B) 距弦桥 29.2cm 处 29.2cm from the bridge
(C) 距弦桥 27.2cm 处 27.2cm from the bridge
(D) 距弦桥 25.2cm 处 25.2cm from the bridge
(E) 以上皆非 None of the above

16. 有一气体，个别分子的质量皆为 m=10^{-25}kg，且 n 表速率为 V 的分子数目，其分布如右表所示，则下列何者为正确？

V(m/sec)	n(mole)
1000	1
2000	2
3000	6
4000	4
5000	2

The mass of the molecule of a gas is $m = 10^{-25}$kg, and n represents the number of the gas with speed V. The velocity distribution is shown in the right table. Which of the following statements is correct?

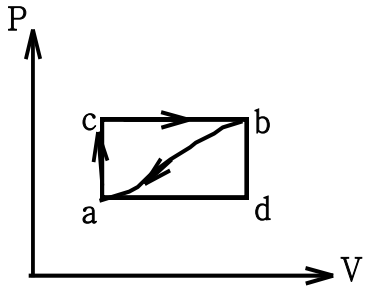
(A) 分子的平均速率为零 the average speed of the molecule is zero
(B) 分子速率的方均根值为 3000 m/s the root mean square of speed of the molecule is 3000m/s
(C) 分子的平均动能为5.9×10^{-19}J the average kinetic energy of the molecule is 5.9×10^{-19}J
(D) 分子最可能的速率为 4000 m/s the most probable speed of the molecule is 4000 m/s
(E) 以上皆非 None of the above

17. 一封闭的容器内含有空气和水蒸气的混合物，在温度为 20℃ 和 75℃ 时，容器内的压强分别为 737.5 mmHg and 1144 mHg。而在 75℃ 时容器内有少量的水存在。如果在 20℃ 时水蒸气压强为 17.5 mmHg，则在 75℃ 时的饱和蒸气的压强为：

Inside a sealed container, there is a mixture of gas and vapor. The pressure in the container is 737.5 mmHg and 1144 mmHg at the temperature 20℃ and 75℃ respectively, and there still has a small amount of water inside container at 75℃ . If the pressure of vapor is 17.5 mmHg at 20℃, what is the saturated vapor pressure at 75℃?

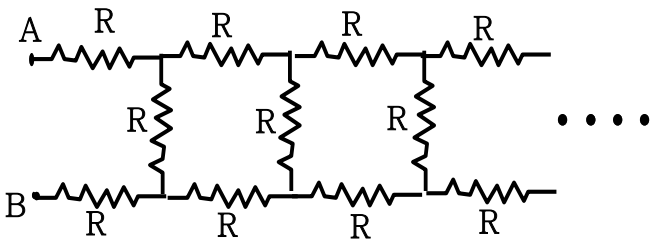
(A) 248.8 mHg
(B) 268.8 mHg
(C) 288.8 mHg
(D) 308.8 mHg
(E) 以上皆非 None of the above

18. 有一热力学系统，在 P-V 图中，沿着过程 acb 从状态 a 变化至状态 b，在此过程吸热 80J，对外界作功 30J。该系统随後沿着曲线路径由状态 b 回到状态 a，假设在此过程中作功 20 J，则在此过程中，系统吸热多少？



When a thermodynamic system is taken from state a to b, along the path acb in P-V diagram,80 J of heat flows into the system, and 30 J of work is done. The system then returns from b to a along the curve path. If the work is 20 J, how much heat does the system absorb in this process?

(A) 70 J
(B) 30 J
(C) -70 J
(D) -30 J
(E) 以上皆非 None of the above



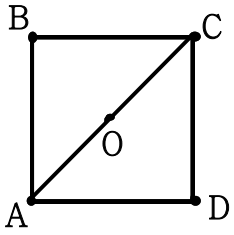
19. 如图中的无限梯阶电路，所有的电阻皆为 R，则 A,B 两端的等效电阻为何?

In the infinite ladder circuit shown in the figure, all resistors are of the same value R. What is the equivalent resistance between A and B?

(A) $(1+\sqrt{3})R$ (B) $(-1+\sqrt{3})R$ (C) $(1+\sqrt{2})R$

(D) $(-1+\sqrt{2})R$ (E) 以上皆非 None of the above

20. 四个相等的电荷固定於一正方形的四个顶点，O 为此正方形的中心。假如将该正方形以一对角线 AC 旋转，角速度为ω，在中心点 O 所产生的磁感应强度为 B_1，假如该将正方形以一通过 O 点且垂直於正方形的平面为轴，以相同的角速度ω旋转，在中心点 O 产生的磁感应强度为 B_2，则 B_1 和 B_2 满足

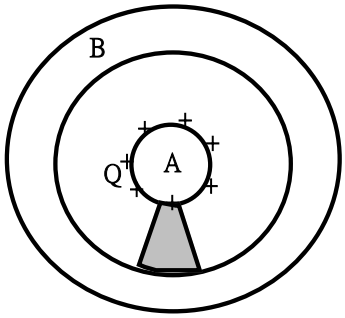


Four identical charges are fixed at the corners of a square ABCD of that O is the center. If we rotate the square about its diagonal AC with a angular velocity ω, the magnetic field strength at point O is B_1. If we rotate the square about the axis which is passing through O and perpendicular to the plane of the square with the same angular velocity ω, the magnetic field strength at point O is B_2. Then B_1 and B_2 have the relation

(A) $B_1=\sqrt{2B_2}$ (B) $B_1=2B_2$ (C) $B_1=4B_2$

(D) $B_1=\frac{B_2}{2}$ (E) $B_1=\frac{B_2}{4}$

21. 如图有一中空而无带电的导体球 B，其内部有另一较小且带有净电荷 Q_A 的导体球 A，此两导体以一绝缘体隔离之。现将此两导体以一导线连接，电荷会重新分配，假设在静电平衡时，A,B 两导体球分配的净电荷分别为 Q_A 和 Q_B，则下面的叙述何者是正确的？



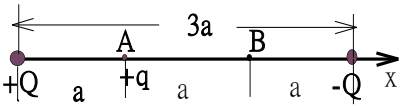
A big hollow conductor B has no net charge on it. Inside B, another conductor A carries a net charge Q and is isolated from B by an insulator. After the two conductors are connected with a conducting wire the charge will redistributed. If the net charges on A and B are Q_A and Q_B at electrostatic equilibrium, which of the following statements is correct?

(A) $Q_A = -Q/2, Q_B = Q/2$　　(B) $Q_A = Q_B = Q/2$

(C) $Q_A = Q, Q_B = 0$　　(D) $Q_A = 0, Q_B = Q$

(E) 以上皆非 None the above

22. 两固定电荷分别带电 $+Q$ 和 $-Q$，相距 $3a$，A,B 分别为其间之三等份点。现有一电荷 $+q$，原先静止於 A 点，受到电力作用而运动至 B，则在 B 点的动能为：

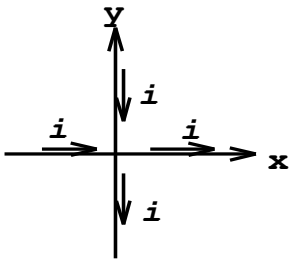


Two fixed point charges +Q and -Q are at a distance 3a apart and A, B are the points of trisection. A charge q initially rests at A and moves toward B under the influence of electric force, what is the kinetic energy of the charge when it arrives point B?

(A) $\frac{kQq}{a}$　　(B) $\frac{kQq}{2a}$　　(C) $\frac{kQq}{3a}$

(D) $\frac{kQq}{4a}$　　(E) 以上皆非 None of the above

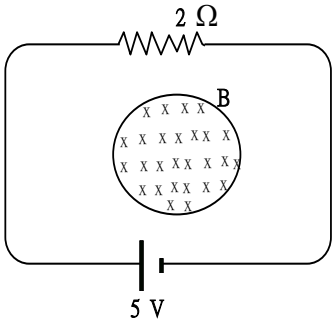
23. 两长导体分别沿着 x 轴和 y 轴，通以相同的电流 i，如图所示，则在 x-y 平面上磁感应强度为零的方程式为



Two long conductors carry the same current i lie along x-axis and y-axis, respectively, as shown in the figure. What is the equation of points on x-y plane where the magnetic field strength is equal to zero?

(A) $x+y=0$
(B) $x-y=0$
(C) $x+\sqrt{2}y=0$
(D) $x-\sqrt{2}y=0$
(E) 以上皆非 None of the above

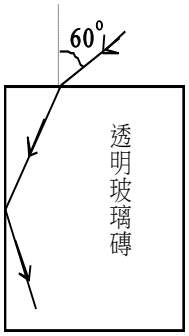
24. 如图的电路，电池的电动势为 5V，电阻为 2Ω,有一均匀的磁场垂直射入该电路所围成的平面，且其截面积为 200cm^2。假设此磁场以 50 T/s 的速率增加，则流经该电路电流为：



Consider the circuit in the figure. The emf of the battery is 5 V and the resistance is 2Ω. There is a uniform magnetic filed intensity passing through the area of the circuit and perpendicular to the circuit with the cross section area of the field 200cm^2 . If the magnetic field intensity increases steady at a rate 50 T/s, what is the current of the circuit?

(A) 5 A
(B) 4 A
(C) 3 A
(D) 2 A
(E) 以上皆非None of the above

25. 如右图中，光以 60°的入射角由空气(n=1) 射入一方形的玻璃的一面，且希望光能在垂直的另一面作全反射，则此玻璃的折射率可能为：



A light is incident with angle 60° from air (n=1) into a glass, and is totally reflected at another vertical side of glass. The index of refraction of the glass may be:

(A) 1.1　　(B) 1.2　　(C) 1.3
(D) 1.4　　(E) 以上皆非 None of the above

26. 在杨氏双缝实验中，若将双缝改以三缝取代，且狭缝的距离不变，则下列叙述何者为正确？

In the Young's double slit experiment, if we replace the two slits with three slits, and keep the distance between slits unchanged, which of the following statements is correct?

(A) 暗线条纹位置不变，但亮线条纹位置改变 The positions of dark fringes are unchanged, but the positions of bright fringes are changed.
(B) 亮线条纹位置不变，但暗线条纹位置改变 The positions of bright fringes are unchanged, but the positions of dark fringes are changed.
(C) 暗线条纹和亮线条纹的位置皆不变 Both positions of bright fringes and dark fringes are unchanged
(D) 暗线条纹和亮线条纹的位置皆改变 Both positions of bright fringes and dark fringes are changed
(E) 以上皆非 None of the above

27. 将某液体加入到牛顿环干涉仪中的透镜和面板中的空气隙，第 10 条干涉条纹的直径由 1.5 cm 变成 1.31 cm。则该液体的折射率为何？

When a liquid is introduced into the air space between the lens and the plate in a Newton's-ring apparatus, the diameter of tenth ring changes from 1.50 cm to 1.31 cm. What is the index of refraction of the liquid.

(A) 1.21 (B) 1.31 (C)1.41 (D) 1.51 (E) 以上皆非None of the above

28. 一双原子气体温度为 T°C，假设 m 表每一原子的质量，则其原子的物资波的波长为何？

A diatomic gas is at temperature T°C and suppose m is the mass of the atom. What is its De Broglie wave length of the atom?

(A) $\frac{h}{\sqrt{3mkT}}$ (B) $\frac{h}{\sqrt{5mkT}}$ (C) $\frac{h}{\sqrt{3mk(273+T)}}$

(D) $\frac{h}{\sqrt{5mk(273+T)}}$ (E) 以上皆非 None of the above

Where h is Planck's constant and k is Boltzmann's constant.

29. 在两固定壁来回运动的粒子，可以产生幅射，此粒子由第一激发态(n=2)跃迁至基态时，其幅射光子频率为ν_1。由第三激发态(n=4)跃迁至基态时，其幅射光子频率为ν_2。则ν_2/ν_1=

A particle moving between two fixed solid walls can produce radiations. Suppose that if the particle transits from the 1st excited state(n=2) to the ground state, it radiates a phonon with frequency ν_1, and if it transits from the 3rd excited sate(n=4) to the ground state, it radiates a phonon with frequency ν_2. Then ν_2/ν_1=

(A) 2 (B) 3 (C) 4
(D) 5 (E) 以上皆非None of the above

30. 在活的生物体内，同位素 ^{14}C 与 ^{12}C 含量的比值为 10^{-13}，且 ^{14}C 的半衰期为 5730 年。现有一古生物，其 ^{14}C 与 ^{12}C 含量的比值为 1.25×10^{-14}，则该古生物死时距今约为

The ratio of ^{14}C to ^{12}C is 10^{-13} in living creature, and the half time of ^{14}C is 5730 years. Now, the ratio of ^{14}C to ^{12}C is 1.25×10^{-14} in an ancient creature, what is the time when the ancient creature died before today.

(A) 11460 years　　(B) 17190 years　　(C)22920 years
(D) 28650 year　　(E) 以上皆非 None of the above

答案:

1. C
2. C
3. C
4. A
5. C
6. C
7. A
8. C
9. C
10. C
11. E
12. B
13. C
14. B
15. A
16. C
17. C
18. C
19. A
20. D
21. D
22. A
23. A
24. D
25. D
26. B
27. B
28. D
29. D
30. B