2026 年 01 月 CSCA 物理考试
January 2026 CSCA Physics Exam

题目(Questions)、答案(Answers)与解析(Explanations)

第 1 题(Question 1)

题目:第 26 届国际计量大会决定重新定义质量的基本单位,该定义于 2019 年 5 月 20 日生效。质量的基本单位是(The 26th International Conference on Weights and Measures decided to redefine the basic unit of mass, which came into effect on May 20, 2019. The basic unit of mass is)

A. N(牛顿, newton)

B. s(秒, second)

C. m(米, meter)

D. kg(千克, kilogram)

答案(Answer):D

解析(Explanation):

- 中文解析:物理中各基本物理量对应国际单位制(SI)单位为:力的单位是 N(选项 A), 时间的单位是 s(选项 B), 长度的单位是 m(选项 C), 质量的基本单位是 kg(选项 D)。

- English Explanation:In physics, the SI units of basic physical quantities are as follows: the unit of force is N (Option A), the unit of time is s (Option B), the unit of length is m (Option C), and the basic unit of mass is kg (Option D).

第 2 题(Question 2)

题目:月球表面的重力加速度约为地球表面的 1/6。若某物体在地球上的重力为 120 牛, 则其在月球上的重力为(The gravitational acceleration on the surface of the moon is about 1/6 of that

on Earth. If the gravity of an object on Earth is 120N, its gravity on Moon is)

A. 60N(60 牛，sixty newtons)

B. 20N(20 牛，twenty newtons)

C. 120N(120 牛，one hundred and twenty newtons)

D. 720N(720 牛，seven hundred and twenty newtons)

答案(Answer):B

解析(Explanation):

- 中文解析:重力的计算公式为 $G = mg$ (G 为重力，m 为质量，g 为重力加速度)。物体的质量不随位置变化，月球上的重力加速度 $g_月 = \frac{1}{6}g_地$ ，因此月球上的重力 $G_月 = \frac{1}{6}G_地 = \frac{120\,\text{N}}{6} = 20\,\text{N}$ 。

- English Explanation: The formula for gravity is $G = mg$ (G is gravity, m is mass, g is gravitational acceleration). The mass of an object does not change with position. The gravitational acceleration on the moon $g_{\text{moon}} = \frac{1}{6}g_{\text{earth}}$, so the gravity on the moon $G_{\text{moon}} = \frac{1}{6}G_{\text{earth}} = \frac{120\,\text{N}}{6} = 20\,\text{N}$.

第 3 题(Question 3)

题目:一根弹簧的原长为 0.7 米，劲度系数 $k = 10\,\text{N/m}$ 。当施加 3 牛的力拉伸该弹簧时，其新长度为(The natural length of a spring is 0.7m, and its spring constant is $k = 10\,\text{N/m}$. When a force of 3N is applied to stretch the spring, its new length is)

A. 0.5m(0.5 米，0.5 meters)

B. 0.7m(0.7 米，0.7 meters)

C. 0.3m(0.3 米，0.3 meters)

D. 1.0m(1.0 米，1.0 meters)
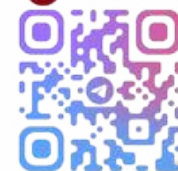
答案(Answer):D

解析(Explanation):

- 中文解析:根据胡克定律(Hooke's Law) $F = kx$ (F 为拉力，k 为劲度系数，x 为弹簧伸长量)，可得伸长量 $x = \frac{F}{k} = \frac{3,N}{10,N/m} = 0.3,m$ 。弹簧新长度 = 原长 + 伸长量 = 0.7,m + 0.3,m = 1.0,m 。

- English Explanation: According to Hooke's Law $F = kx$ (F is the tensile force, k is the spring constant, x is the elongation of the spring), the elongation $x = \frac{F}{k} = \frac{3,N}{10,N/m} = 0.3,m$. The new length of the spring = natural length + elongation = 0.7,m + 0.3,m = 1.0,m .

第 4 题(Question 4)

题目:假设某物体受到两个力 F_1 和 F_2 的作用，已知 $F_1 = 3,N$ 、 $F_2 = 5,N$ ，则这两个力的合力大小不可能为(Suppose that an object is subjected to two forces F_1 and F_2 . Given that $F_1 = 3,N$ and $F_2 = 5,N$, the magnitude of the resultant force of these two forces cannot be)

A. 2N(2 牛，two newtons)

B. 9N(9 牛，nine newtons)

C. 5N(5 牛，five newtons)

D. 8N(8 牛，eight newtons)

答案(Answer):B

解析(Explanation):

- 中文解析:根据力的合成平行四边形定则(parallelogram rule of force composition)，两个力的合力大小范围为 $|F_2 - F_1| \le F_合 \le F_1 + F_2$ 。代入数据得 $2,N \le F_合 \le 8,N$ ，因此合力不可能为 9N。

第 5 题(Question 5)

题目:在匀强磁场中,一根长度为 0.5 米的直导线垂直于磁场方向放置,当通过 10 安的电流时,导线受到 1.5 牛的安培力。该磁场的磁感应强度大小为(In a uniform magnetic field, a straight wire with length 0.5m is placed perpendicular to the direction of the magnetic field. When passing through a current of 10A it experiences an Ampere force of 1.5N. The magnitude of the magnetic induction intensity of the magnetic field is)

A. 0.3T(0.3 特斯拉, 0.3 tesla)

B. 0.2T(0.2 特斯拉, 0.2 tesla)

C. 0.4T(0.4 特斯拉, 0.4 tesla)

D. 0.1T(0.1 特斯拉, 0.1 tesla)

答案(Answer):A

解析(Explanation):

- 中文解析:安培力公式为 $F = BIL\sin\theta$ (B 为磁感应强度, I 为电流, L 为导线长度, θ 为电流与磁场方向夹角)。因导线垂直磁场, $\theta = 90°$, $\sin 90° = 1$, 故 $B = \frac{F}{IL} = \frac{1.5\,N}{10\,A \times 0.5\,m} = 0.3\,T$ 。

- English Explanation:The formula for Ampere force is $F = BIL\sin\theta$ (B is magnetic induction intensity, I is current, L is wire length, θ is the angle between current and magnetic field direction). Since the wire is perpendicular to the magnetic field, $\theta = 90°$

and $\sin 90° = 1$, so $B = \frac{F}{IL} = \frac{1.5,N}{10,A×0.5,m} = 0.3,T$.

第 6 题(Question 6)

题目:乒乓球非常适合亚洲人的身体特点，是中国的国球。下列关于乒乓球的说法正确的是

(Table tennis is very suitable for the characteristics of Asians and is the national sport of China. Which of the following statements about table tennis is correct?)

A. 乒乓球体积较小，任何时候都可视为质点(Ping Pong is relatively small and can be viewed as a particle at any time)

B. 研究乒乓球的飞行轨迹时，可将其视为质点(When studying the flight path of the ball, it can be viewed as a particle)

C. 乒乓球在空中飞行过程中的位移大小等于路程(The displacement of the ball during its flight in the air is equal to the distance traveled)

D. 研究乒乓球的旋转时，必须将其视为质点(When studying the rotation of the ball, one must consider it as a particle)

答案(Answer):B
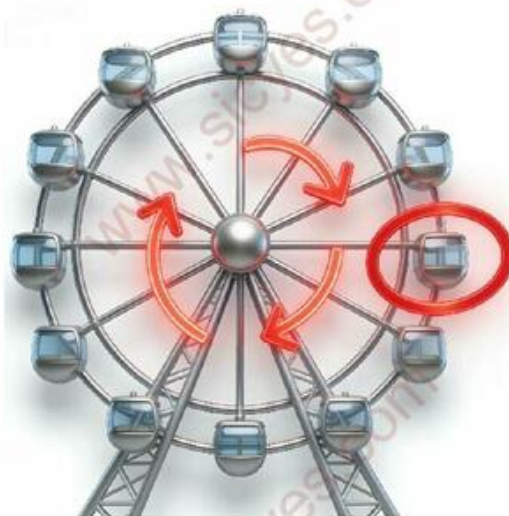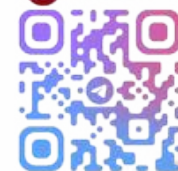
解析(Explanation):

- 中文解析:质点是忽略物体形状和大小的理想化模型(idealized model)，其能否视为质点取决于研究问题:

  1. 选项 A 错误:研究乒乓球旋转时，形状大小不可忽略，不能视为质点;

  2. 选项 B 正确:研究飞行轨迹时，乒乓球的形状大小对轨迹影响极小，可视为质点;

  3. 选项 C 错误:位移是初末位置的有向线段(vector)，路程是运动轨迹长度(scalar)，乒乓球飞行轨迹为曲线，位移大小小于路程;

  4. 选项 D 错误:研究旋转时，需关注球的各点运动差异，不能视为质点。

- English Explanation:A particle is an idealized model that ignores the shape and size of an object. Whether it can be regarded as a particle depends on the research question:

  1. Option A is incorrect: When studying the rotation of table tennis, its shape and size cannot be ignored, so it cannot be regarded as a particle;

  2. Option B is correct: When studying the flight path, the shape and size of table tennis have little effect on the trajectory, so it can be regarded as a particle;

  3. Option C is incorrect: Displacement is a directed line segment between the initial and final positions (vector), and distance is the length of the movement trajectory (scalar). The flight trajectory of table tennis is curved, so the magnitude of displacement is less than the distance;

  4. Option D is incorrect: When studying rotation, it is necessary to pay attention to the motion differences of each point of the ball, so it cannot be regarded as a particle.

第 7 题(Question 7)

题目:摩天轮的半径为 R，座舱随摩天轮转动一周，其通过的路程和位移分别为(The radius of a Ferris wheel is R. The cabin rotates with the wheel once, and its distance and displacement are)

A. 路程 $2\pi R$ ，位移 2R(distance $2\pi R$ ，displacement 2R)

B. 路程 2R，位移 $2\pi R$ (distance 2R, displacement $2\pi R$)

C. 路程 2R，位移 0(distance 2R, displacement 0)

D. 路程 $2\pi R$ ，位移 0(distance $2\pi R$ ，displacement 0)

答案(Answer):D

解析(Explanation):

- 中文解析:

  1. 路程(distance):标量，指物体运动轨迹的长度，摩天轮转动一周的轨迹为圆周，路程等于圆的周长 $2\pi R$ ；

  2. 位移(displacement):矢量，指物体初末位置的有向线段，座舱转动一周后回到初始位置，初末位置重合，位移大小为 0。

- English Explanation:

  1. Distance: A scalar quantity referring to the length of the object's movement trajectory. The trajectory of the cabin rotating once with the Ferris wheel is a circle, and the distance is equal to the circumference of the circle $2\pi R$ ；

  2. Displacement: A vector quantity referring to the directed line segment between the initial and final positions of the object. After the cabin rotates once, it returns to the initial position, so the initial and final positions coincide, and the magnitude of displacement is 0.

第 8 题(Question 8)

题目:下列说法不正确的是(Which of the following statements is incorrect?)

A. 在结冰的水平路面上撒一些细土，人不易滑倒，因为人与路面间的最大静摩擦力增大了

(Sprinkling some fine soil on a frozen horizontal road surface would make it less likely for people to slip on it, because the maximum static friction between the people and the road surface increases)

B. 竖直握住空中的瓶子，当手的握力增大时，瓶子受到的摩擦力不变(Hold a bottle in the hand vertically in the air. When the grip of the hand is increased, the frictional force on the bottle remains unchanged)

C. 人行走时，受到的是静摩擦力(When walking, people are subjected to static friction)

D. 人双手握住竖直固定的竹竿匀速上爬时，受到的摩擦力方向向下(When a person climbs a vertically fixed bamboo pole with both hands at a constant speed, the direction of the frictional force experienced is downward)

答案(Answer):D

解析(Explanation):

- 中文解析:

1. 选项 A 正确:撒细土增大了路面粗糙程度，提高了动摩擦因数，从而增大最大静摩擦力，减少滑倒风险;

2. 选项 B 正确:竖直握住瓶子时，瓶子受重力和静摩擦力平衡($f = G$)，握力增大仅增大正压力，不影响静摩擦力大小;

3. 选项 C 正确:人行走时，脚与地面无相对滑动，地面给脚的静摩擦力是前进的动力;

4. 选项 D 错误:人匀速上爬时，竖直方向受重力和静摩擦力平衡，重力向下，故摩擦力方向向上。

- English Explanation:

1. Option A is correct: Sprinkling fine soil increases the roughness of the road surface,

improves the coefficient of kinetic friction, thereby increasing the maximum static friction and reducing the risk of slipping;

2. Option B is correct: When holding the bottle vertically, the bottle is balanced by gravity and static friction ($f = G$). Increasing the grip only increases the normal pressure, but does not affect the magnitude of static friction;

3. Option C is correct: When a person walks, there is no relative sliding between the feet and the ground, and the static friction from the ground on the feet is the driving force for forward movement;

4. Option D is incorrect: When a person climbs at a constant speed, the vertical direction is balanced by gravity and static friction. Gravity is downward, so the direction of friction is upward.

第 9 题(Question 9)

题目:下列哪个图像表示汽车做匀加速直线运动？(Which of the following graphs represents the motion of a car moving on a straight line with constant acceleration?)
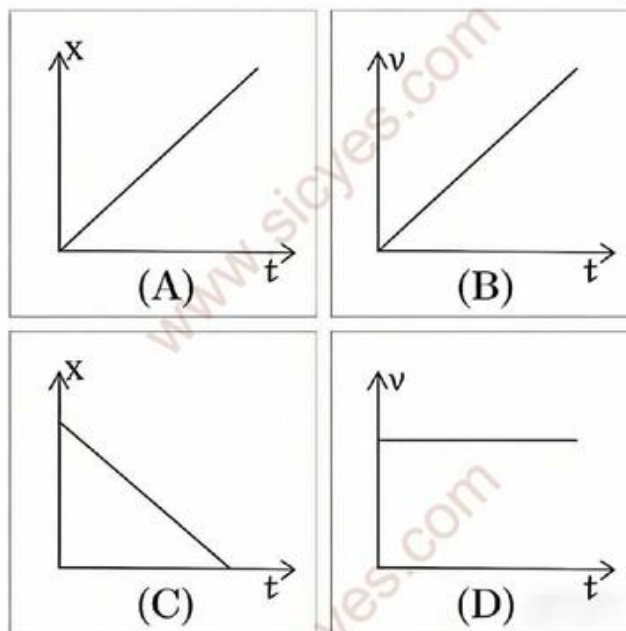
答案(Answer):B

解析(Explanation):

- 中文解析:匀加速直线运动(uniformly accelerated straight motion)的核心特征是"速度随时间均匀增大",对应的图像判断规则:

  1. v-t 图像(速度-时间图像):匀加速直线运动的图像是倾斜向上的直线(斜率表示加速度,恒定不变);

  2. x-t 图像(位移-时间图像):匀加速直线运动的图像是抛物线(斜率表示速度,随时间增大)。

- English Explanation:The core feature of uniformly accelerated straight motion is "velocity increases uniformly with time", and the corresponding image judgment rules:

  1. v-t graph (velocity-time graph): The graph of uniformly accelerated straight motion is an upward-sloping straight line (the slope represents acceleration, which is constant);

  2. x-t graph (displacement-time graph): The graph of uniformly accelerated straight motion is a parabola (the slope represents velocity, which increases with time).

第 10 题(Question 10)

题目:一个物体从 5 米高处自由下落,到达地面所需的时间为($g = 10, \text{m/s}^2$)(An object falls freely from a height of 5m. The time it takes to reach the ground is ($g = 10, \text{m/s}^2$))

A. 4s(4 秒,4 seconds)

B. 1s(1 秒,1 second)

C. 2s(2 秒,2 seconds)

D. 3s(3 秒,3 seconds)

答案(Answer):B

解析(Explanation):

- 中文解析:自由落体运动(free fall motion)是初速度为 0、加速度为 g 的匀加速直线运动,位移公式为 $h = \frac{1}{2}gt^2$。变形得 $t = \sqrt{\frac{2h}{g}}$,代入 $h = 5\,m$、$g = 10\,m/s^2$,得 $t = \sqrt{\frac{2 \times 5}{10}} = 1\,s$。

- English Explanation:Free fall motion is a uniformly accelerated straight motion with an initial velocity of 0 and an acceleration of g. The displacement formula is $h = \frac{1}{2}gt^2$. Rearranging gives $t = \sqrt{\frac{2h}{g}}$. Substituting $h = 5\,m$ and $g = 10\,m/s^2$, we get $t = \sqrt{\frac{2 \times 5}{10}} = 1\,s$.

第 11 题(Question 11)

题目:一个物体以 0.1 米为半径做匀速圆周运动,周期为 5 秒,该物体运动的线速度和角速度分别为(An object moves in a uniform circular motion with a radius of 0.1m and a period of 5s. The linear velocity and angular velocity of the object during motion are, respectively,)

A. $100\pi\,m/s$,$0.4\pi\,rad/s$(100π,米/秒,0.4π,弧度/秒)

B. $0.4\pi\,m/s$,$0.4\pi\,rad/s$(0.4π,米/秒,0.4π,弧度/秒)

C. $0.5\pi\,m/s$,$100\pi\,rad/s$(0.5π,米/秒,100π,弧度/秒)

D. $0.04\pi\,m/s$,$0.4\pi\,rad/s$(0.04π,米/秒,0.4π,弧度/秒)

答案(Answer):D

解析(Explanation):

- 中文解析:

1. 线速度(linear velocity)公式: $v = \frac{2\pi r}{T}$ (r 为半径,T 为周期),代入数据得 $v = \frac{2\pi \times 0.1\,m}{5\,s} = 0.04\pi\,m/s$;

2. 角速度(angular velocity)公式: $\omega = \frac{2\pi}{T}$ ，代入数据得 $\omega = \frac{2\pi}{5,s} = 0.4\pi,rad/s$ 。

- English Explanation:

 1. Formula for linear velocity: $v = \frac{2\pi r}{T}$ (r is radius, T is period). Substituting the data, we get $v = \frac{2\pi \times 0.1,m}{5,s} = 0.04\pi,m/s$;

  2. Formula for angular velocity: $\omega = \frac{2\pi}{T}$. Substituting the data, we get $\omega = \frac{2\pi}{5,s} = 0.4\pi,rad/s$.

第 12 题(Question 12)

题目:某玩具车沿直线运动的位移(x)随时间(t)变化的图像如图所示，下列说法正确的是(The graph of the displacement (x) of a toy car moving in a straight line changing with time (t) is shown in the figure. Which of the following statements is correct?)
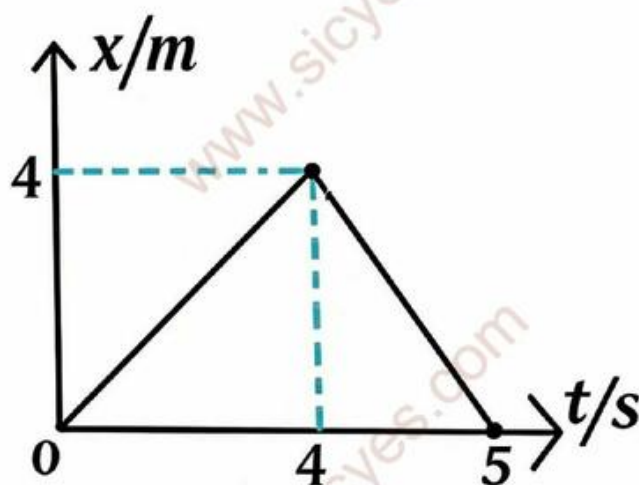
A. 0-4 秒内，玩具车的位移为 8 米(Within 0-4 seconds, the displacement of the toy car's movement is 8m)

B. 0-4 秒内，玩具车的速度为 1.0 米/秒(Within 0-4 seconds, the speed of the toy car is 1.0m/s)

C. 0-5 秒内，玩具车的平均速度为 0.8 米/秒(Within 0-5 seconds, the average speed of the

toy car is 0.8m/s)

D. 4-5 秒内，玩具车的速度为 0.8 米/秒(Within 4-5 seconds, the speed of the toy car is 0.8m/s)

答案(Answer):B

解析(Explanation):

- 中文解析:

    1. 位移分析(选项 A):位移是初位置到末位置的有向线段。0-4 秒内，玩具车从 x=0m 运动到 x=4m，位移大小为 4m，并非 8m。因此，选项 A 错误。

    2. 速度分析(选项 B):在 x-t 图像中，图线的斜率表示速度。0-4 秒内，图像为一条倾斜直线，说明玩具车做匀速直线运动。其速度大小为 $v = \frac{\Delta x}{\Delta t} = \frac{4\,m - 0\,m}{4\,s - 0\,s} = 1.0\,m/s$ 。因此，选项 B 正确。

    3. 平均速度分析(选项 C):平均速度等于总位移除以总时间。0-5 秒内，玩具车从 x=0m 出发，最终回到 x=0m，总位移为 0。因此，平均速度 $\bar{v} = \frac{0}{5\,s} = 0\,m/s$ 。选项 C 错误。

    4. 速度分析(选项 D):4-5 秒内，图像同样为倾斜直线，玩具车做匀速直线运动。其速度大小为 $v = \frac{\Delta x}{\Delta t} = \frac{0\,m - 4\,m}{5\,s - 4\,s} = -4\,m/s$ ，负号表示方向与正方向相反，速度大小为 4m/s，并非 0.8m/s。因此，选项 D 错误。

- English Explanation:

    1. Displacement Analysis (Option A):Displacement is a directed line segment from the initial position to the final position. Within 0-4 seconds, the toy car moves from x=0m to x=4m, so the displacement magnitude is 4m, not 8m. Therefore, Option A is incorrect.

2. Velocity Analysis (Option B):In an x-t graph, the slope of the line represents velocity. Within 0-4 seconds, the graph is an inclined straight line, indicating the toy car is moving in uniform linear motion. Its velocity magnitude is $v = \frac{\Delta x}{\Delta t} = \frac{4\,m-0\,m}{4\,s-0\,s} = 1.0\,m/s$. Therefore, Option B is correct.

3. Average Velocity Analysis (Option C):Average velocity is equal to total displacement divided by total time. Within 0-5 seconds, the toy car starts at x=0m and returns to x=0m, so the total displacement is 0. Therefore, the average velocity $\bar{v} = \frac{0}{5\,s} = 0\,m/s$. Option C is incorrect.

4. Velocity Analysis (Option D):Within 4-5 seconds, the graph is also an inclined straight line, meaning the toy car is in uniform linear motion. Its velocity magnitude is $v = \frac{\Delta x}{\Delta t} = \frac{0\,m-4\,m}{5\,s-4\,s} = -4\,m/s$. The negative sign indicates the direction is opposite to the positive direction, and the velocity magnitude is 4m/s, not 0.8m/s. Therefore, Option D is incorrect.

第 13 题(Question 13)

题目:当电梯以 $2\,m/s^2$ 的加速度竖直向上加速运动时，电梯内质量为 50 千克的人对地板的压力为($g = 10\,m/s^2$)(When an elevator accelerates vertically upwards with an acceleration of $2\,m/s^2$, the pressure exerted on the floor by a person with a mass of 50kg inside the elevator is ($g = 10\,m/s^2$))

A. 500N(500 牛， 500 newtons)

B. 300N(300 牛， 300 newtons)

C. 400N(400 牛， 400 newtons)

D. 600N(600 牛， 600 newtons)

答案(Answer):D

解析(Explanation):

- 中文解析:电梯向上加速时，人处于超重状态(overweight state)。对人进行受力分析:受重力 mg (向下)和地板支持力 N (向上)。根据牛顿第二定律 $N - mg = ma$，得 $N = m(g + a) = 50\,\text{kg} \times (10 + 2)\,\text{m/s}^2 = 600\,\text{N}$。根据牛顿第三定律，人对地板的压力等于支持力，即 600N。

- English Explanation:When the elevator accelerates upward, the person is in an overweight state. Force analysis on the person: subject to gravity mg (downward) and floor support force N (upward). According to Newton's second law $N - mg = ma$, we get $N = m(g + a) = 50\,\text{kg} \times (10 + 2)\,\text{m/s}^2 = 600\,\text{N}$. According to Newton's third law, the pressure exerted by the person on the floor is equal to the support force, which is 600N.

第 14 题(Question 14)

题目:如图所示，一个质量为 1 千克的物体沿水平地面向右滑动，已知物体受到的滑动摩擦力为 3 牛，$g = 10\,\text{m/s}^2$，则物体与水平地面间的动摩擦因数为(As shown in the figure, an object with a mass of 1kg slides to the right along a horizontal ground. Given that the sliding friction force acting on the object is 3N, and $g = 10\,\text{m/s}^2$, the coefficient of kinetic friction between the object and the horizontal ground is)
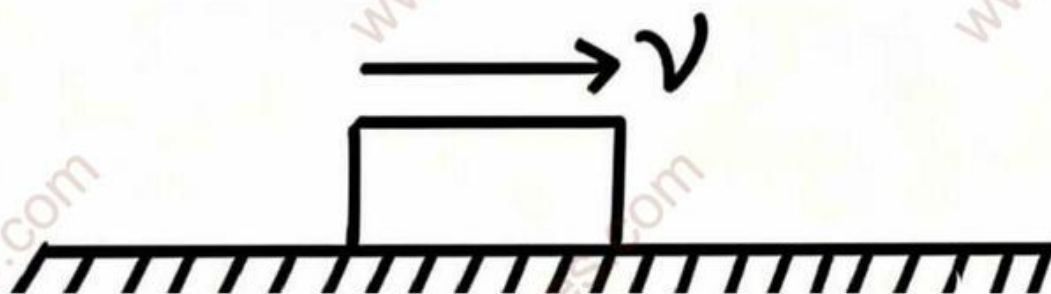
A. 0.2(0.2)

B. 0.3(0.3)

C. 1(1)

D. 0.4(0.4)

答案(Answer):B

解析(Explanation):

- 中文解析:滑动摩擦力(sliding friction)公式为 $f = \mu N$ (μ 为动摩擦因数，N 为正压力)。水平地面上，物体对地面的正压力等于重力 $N = mg$ ，因此 $\mu = \frac{f}{mg} = \frac{3,N}{1,kg \times 10,m/s^2} = 0.3$ 。

- English Explanation:The formula for sliding friction is $f = \mu N$ (μ is the coefficient of kinetic friction, N is the normal pressure). On a horizontal ground, the normal pressure of the object on the ground is equal to the gravity $N = mg$, so $\mu = \frac{f}{mg} = \frac{3,N}{1,kg \times 10,m/s^2} = 0.3$ 。

第 15 题(Question 15)

题目:在光滑水平面上，对一个静止的质量为 1.0 千克的物体施加一个水平恒力 F，测得其 1 秒内速度变化量的大小为 10 米/秒，则力 F 的大小为(On a smooth horizontal surface, a constant force F is applied horizontally to a stationary object with a mass of 1.0kg, and the magnitude of its velocity change within 1 second is measured to be 10m/s. Therefore, the magnitude of the force F is)

A. 40N(40 牛，40 newtons)

B. 5N(5 牛，5 newtons)

C. 10N(10 牛，10 newtons)

D. 20N(20 牛，20 newtons)

答案(Answer):C

解析(Explanation):

- 中文解析:首先根据加速度定义(definition of acceleration) $a = \frac{\Delta v}{\Delta t}$ ，得 $a = \frac{10,\text{m/s}}{1,\text{s}} = 10,\text{m/s}^2$ 。再根据牛顿第二定律(Newton's second law) $F = ma$ ，代入 $m = 1.0,\text{kg}$ 、 $a = 10,\text{m/s}^2$ ，得 $F = 10,\text{N}$ 。

- English Explanation:First, according to the definition of acceleration $a = \frac{\Delta v}{\Delta t}$, we get $a = \frac{10,\text{m/s}}{1,\text{s}} = 10,\text{m/s}^2$. Then, according to Newton's second law $F = ma$, substituting $m = 1.0,\text{kg}$ and $a = 10,\text{m/s}^2$, we get $F = 10,\text{N}$.

第 16 题(Question 16)

题目:光从空气射入某种介质时，入射角 $i = 60°$ ，折射角 $r = 30°$ ，若空气的折射率 $n = 1$ ，则该介质的折射率为(When light enters a medium from air, with an angle of incidence $i = 60°$, the angle of refraction is $r = 30°$. If the refractive index of air is $n = 1$, the refractive index of the medium is)

A. $\sqrt{3}$

B. 3(3)

C. 1.5(1.5)

D. $\sqrt{5}$

答案(Answer):A

解析(Explanation):

- 中文解析:根据折射定律(Snell's Law) $n_1 \sin i = n_2 \sin r$ （ n_1 为入射介质折射率， n_2 为折射介质折射率，i 为入射角，r 为折射角)。代入数据 $1 \times \sin 60° = n_2 \times \sin 30°$ ，因

$$\sin 60° = \frac{\sqrt{3}}{2} 、 \sin 30° = \frac{1}{2}, \text{ 解得 } n_2 = \sqrt{3} 。$$

- English Explanation:According to Snell's Law $n_1 \sin i = n_2 \sin r$（ n_1 is the refractive index of the incident medium, n_2 is the refractive index of the refracted medium, i is the angle of incidence, r is the angle of refraction). Substituting the data $1 \times \sin 60° = n_2 \times \sin 30°$, since $\sin 60° = \frac{\sqrt{3}}{2}$ and $\sin 30° = \frac{1}{2}$, we solve for $n_2 = \sqrt{3}$.

第 17 题(Question 17)

题目:一个小球以 100π,rad/s 的角速度做匀速圆周运动，小球到圆心的距离为 1 厘米，则小球的向心加速度为(A small ball is in uniform circular motion with an angular velocity of 100π,rad/s . The distance between the ball and the center of the circle is 1cm. The centripetal acceleration of the ball is)

A. $50\pi^2$,m/s² （ $50\pi^2$,米/秒² ）

B. $100\pi^2$,m/s² （ $100\pi^2$,米/秒² ）

C. $10000\pi^2$,m/s² （ $10000\pi^2$,米/秒² ）

D. π,m/s² （ π,米/秒² ）

答案(Answer):B

解析(Explanation):

- 中文解析:向心加速度(centripetal acceleration)的公式为 $a = \omega^2 r$ (ω 为角速度，r 为圆周运动半径)。注意单位统一:r = 1cm = 0.01m，代入数据得 $a = (100\pi,\text{rad/s})^2 \times 0.01,\text{m} = 100\pi^2$,m/s² 。

- English Explanation:The formula for centripetal acceleration is $a = \omega^2 r$ (ω is angular velocity, r is the radius of circular motion). Note the unit unification: r = 1cm = 0.01m. Substituting the data, we get $a = (100\pi,\text{rad/s})^2 \times 0.01,\text{m} = 100\pi^2$,m/s² .

第 18 题(Question 18)

如图所示，弹簧振子在 A、B 之间做简谐运动，O 为平衡位置，测得 A、B 间距为 6cm，小球完成 30 次全振动所用时间为 60s，则(As shown in the figure, a spring oscillator performs simple harmonic motion between A and B, with O as the equilibrium position. The distance between A and B is measured to be 6 cm, and the time taken for the ball to complete 30 full oscillations is 60 s. Then,)
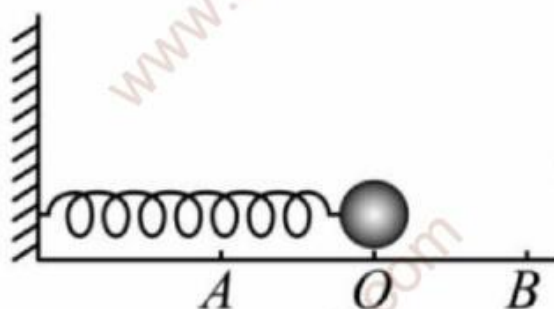
A. 若从小球经过 O 点开始计时，3 秒内小球通过的路程为 24cm(If the timing starts when the ball passes point O, the distance traveled by the ball within 3 seconds is 24 cm)

B. 小球完成一次全振动通过的路程为 12cm(The distance traveled by the ball in one complete oscillation is 12 cm)

C. 该振子的周期为 2s，振幅为 6cm(The period of the oscillator is 2 s, and the amplitude is 6 cm)

D. 该振子的频率为 2Hz(The frequency of the oscillator is 2 Hz)

答案(Answer)B

解析(Explanation):

核心物理量计算(Calculation of core physical quantities)

首先计算简谐运动的核心物理量：

1. 周期(Period):全振动次数 $N = 30$，总时间 $t = 60\,\text{s}$，故周期 $T = \frac{t}{N} = \frac{60\,\text{s}}{30} = 2\,\text{s}$；

2. 频率(Frequency): $f = \frac{1}{T} = \frac{1}{2\,\text{s}} = 0.5\,\text{Hz}$;

3. 振幅(Amplitude):A、B 是简谐运动的两个端点，振幅为平衡位置 O 到端点的距离，故振

   幅 $A = \frac{6\,\text{cm}}{2} = 3\,\text{cm}$ 。

First, calculate the core physical quantities of simple harmonic motion:

1. Period: The number of full oscillations is $N = 30$, and the total time is $t = 60\,\text{s}$, so the

   period $T = \frac{t}{N} = \frac{60\,\text{s}}{30} = 2\,\text{s}$;

2. Frequency: $f = \frac{1}{T} = \frac{1}{2\,\text{s}} = 0.5\,\text{Hz}$;

3. Amplitude: A and B are the two endpoints of simple harmonic motion, and the amplitude

   is the distance from the equilibrium position O to the endpoint, so the amplitude $A =$

   $\frac{6\,\text{cm}}{2} = 3\,\text{cm}$.

选项分析(Analysis of options)

选项 A:3 秒对应的周期数为 $\frac{3\,\text{s}}{2\,\text{s}} = 1.5$ 个周期。简谐运动中，1 个周期的路程为 $4A = $

$4 \times 3\,\text{cm} = 12\,\text{cm}$ ，0.5 个周期的路程为 $2A = 6\,\text{cm}$ ，故 1.5 个周期的路程为 $12\,\text{cm} + 6\,\text{cm} = $

$18\,\text{cm} \neq 24\,\text{cm}$ ， A 错误。

The number of periods corresponding to 3 seconds is $\frac{3\,\text{s}}{2\,\text{s}} = 1.5$ periods. In simple harmonic

motion, the distance traveled in 1 period is $4A = 4 \times 3\,\text{cm} = 12\,\text{cm}$, and the distance traveled

in 0.5 periods is $2A = 6\,\text{cm}$. Therefore, the distance traveled in 1.5 periods is $12\,\text{cm} + 6\,\text{cm} = $

$18\,\text{cm} \neq 24\,\text{cm}$, so option A is incorrect.

选项 B:一次全振动(1 个周期)的路程为 4 倍振幅，即 $4 \times 3\,\text{cm} = 12\,\text{cm}$ ， B 正确。

The distance traveled in one full oscillation (1 period) is 4 times the amplitude, i.e., $4 \times 3\,\text{cm} = $

$12\,\text{cm}$, so option B is correct.

选项 C:周期 $2\,\text{s}$ 的计算正确，但振幅为 $3\,\text{cm}$ (非 $6\,\text{cm}$)， C 错误。

The calculation of the period (2 s) is correct, but the amplitude is 3 cm (not 6 cm), so option C is incorrect.

选项 D:频率为 $0.5\,\text{Hz} \neq 2\,\text{Hz}$ ，D 错误。

The frequency is $0.5\,\text{Hz} \neq 2\,\text{Hz}$, so option D is incorrect.

第 19 题(Question 19)

题目:一个质量为 50 千克的物体以 10 米/秒的速度水平向右运动，其动量和动能分别为(An object with a mass of 50kg moves horizontally towards the right at a speed of 10m/s. The momentum and kinetic energy are, respectively,)

A. 500,kg·m/s ， 2500J(500,千克·米/秒 ， 2500 焦耳，2500 joules)

B. 2500,kg·m/s ， 500J(2500,千克·米/秒 ， 500 焦耳，500 joules)

C. 500,kg·m/s ， 5000J(500,千克·米/秒 ， 5000 焦耳，5000 joules)

D. 5,kg·m/s ， 500J(5,千克·米/秒 ， 500 焦耳，500 joules)

答案(Answer):A

解析(Explanation):

- 中文解析:

  1. 动量(momentum):矢量，公式 $p = mv$ ，代入数据得 $p = 50,\text{kg} \times 10,\text{m/s} = 500,\text{kg·m/s}$ ；

  2. 动能(kinetic energy):标量，公式 $E_k = \frac{1}{2}mv^2$ ，代入数据得 $E_k = \frac{1}{2} \times 50,\text{kg} \times (10,\text{m/s})^2 = 2500,\text{J}$ 。

- English Explanation:

  1. Momentum: A vector quantity, formula $p = mv$. Substituting the data, we get $p = 50,\text{kg} \times 10,\text{m/s} = 500,\text{kg·m/s}$ ；

2. Kinetic energy: A scalar quantity, formula $E_k = \frac{1}{2}mv^2$. Substituting the data, we get

$$E_k = \frac{1}{2} \times 50,kg \times (10,m/s)^2 = 2500,J .$$

第 20 题(Question 20)

题目:一滴初速度为零的水滴从 5 米高的屋檐落下(不计空气阻力),水滴落到地面时的速度为($g = 10,m/s^2$)(If a water droplet with zero initial velocity falls from a 5-meter high eaves (excluding air resistance), the speed at which the water droplet falls to the ground is ($g = 10,m/s^2$))

A. 5m/s(5 米/秒, 5 meters per second)

B. 10m/s(10 米/秒, 10 meters per second)

C. 2m/s(2 米/秒, 2 meters per second)

D. 20m/s(20 米/秒, 20 meters per second)

答案(Answer):B

解析(Explanation):

- 中文解析:自由落体运动的速度-位移公式(velocity-displacement formula)为 $v^2 = 2gh$ (v 为末速度,g 为重力加速度,h 为下落高度)。代入数据得 $v = \sqrt{2 \times 10,m/s^2 \times 5,m} = \sqrt{100} = 10,m/s$ 。

- English Explanation:The velocity-displacement formula for free fall motion is $v^2 = 2gh$ (v is the final velocity, g is the gravitational acceleration, h is the falling height). Substituting the data, we get $v = \sqrt{2 \times 10,m/s^2 \times 5,m} = \sqrt{100} = 10,m/s$.

第 21 题(Question 21)

题目:一个木箱在与水平方向成 37° 角的拉力 $F = 50,N$ 作用下,在水平面上移动了 10 米,

已知 $\cos37° \approx 0.8$ ，则拉力 F 对木箱做的功为(A wooden box is pulled by a force $F = 50$,N at an angle of $37°$ to the horizontal direction, which causes it to move a distance of 10m on a horizontal surface. Given that $\cos37° \approx 0.8$, the work done by the force F on the box is)

    A. 400J(400 焦耳， 400 joules)

    B. 300J(300 焦耳， 300 joules)

    C. 500J(500 焦耳， 500 joules)

    D. 250J(250 焦耳， 250 joules)

答案(Answer):A

解析(Explanation):

- 中文解析:恒力做功(work done by constant force)的公式为 $W = Fs\cos\theta$ (F 为恒力大小，s 为位移大小，θ 为力与位移方向的夹角)。代入数据得 $W = 50,N \times 10,m \times 0.8 = 400,J$ 。

- English Explanation:The formula for work done by a constant force is $W = Fs\cos\theta$ (F is the magnitude of the constant force, s is the magnitude of displacement, θ is the angle between the force and displacement directions). Substituting the data, we get $W = 50,N \times 10,m \times 0.8 = 400,J$.

第 22 题(Question 22)
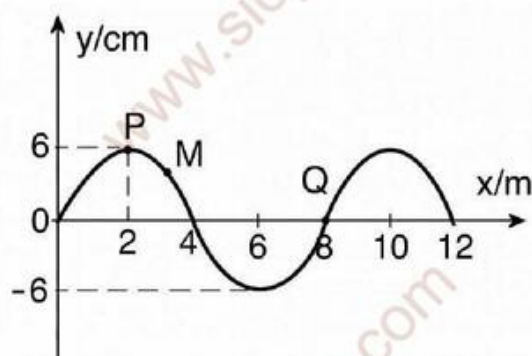
一列简谐横波沿 x 轴正方向传播，波速为 10 米/秒， t=0 时刻的波形如图所示，下列说法正

确的是(A simple harmonic transverse wave propagates along the positive direction of the x-axis, with a wave velocity of 10m/s. The waveform at t=0 is shown in the figure. Which of the following statements is correct?)

A. 0~0.6 秒内，质点 P 运动的路程为 18cm(Within 0~0.6s, the distance traveled by particle P is 18cm)

B. t=0.6s 时刻，质点 P 相对平衡位置的位移是 6cm(At t=0.6s, the displacement of particle P relative to the equilibrium position is 6cm)

C. t=1.2s 时刻，质点 Q 加速度最大(At t=1.2s, the acceleration of particle Q is maximum)

D. t=1.4s 时刻，质点 M 沿 y 轴负方向运动(At t=1.4s, particle M moves along the negative y-axis direction)

答案(Answer)A

解析(Explanation)

核心物理量计算(Calculation of core physical quantities)

首先根据配图(波形图)和题干条件，计算简谐横波的核心物理量:

1. 波长(Wavelength):由配图可知，相邻波峰(或波谷)的间距为 8m，故波长 $\lambda = 8\,\mathrm{m}$;

2. 周期(Period):由波速公式 $v = \frac{\lambda}{T}$ ，得周期 $T = \frac{\lambda}{v} = \frac{8\,\mathrm{m}}{10\,\mathrm{m/s}} = 0.8\,\mathrm{s}$;

3. 振幅(Amplitude):由配图中 y 的最大值可知，振幅 $A = 6\,\mathrm{cm}$ 。

First, calculate the core physical quantities of the simple harmonic transverse wave according to the figure (waveform diagram) and the question conditions:

1. Wavelength: It can be seen from the figure that the distance between adjacent wave crests (or troughs) is 8m, so the wavelength $\lambda = 8\,\mathrm{m}$;

2. Period: From the wave velocity formula $v = \frac{\lambda}{T}$, the period $T = \frac{\lambda}{v} = \frac{8\,\mathrm{m}}{10\,\mathrm{m/s}} = 0.8\,\mathrm{s}$;

3. Amplitude: From the maximum value of y in the figure, the amplitude $A = 6\ \text{cm}$.

选项分析(Analysis of options)

- 选项 A:0~0.6s 的时间间隔 $\Delta t = 0.6\ \text{s} = \frac{3}{4}T$。t=0 时质点 P 位于波峰(位移最大处),简谐运动中,质点从波峰开始运动,$\frac{3}{4}$ 周期内的路程为 $3A$ (波峰→平衡位置→波谷→平衡位置,共 3 段振幅距离)。代入 $A = 6\ \text{cm}$,得路程 $3 \times 6\ \text{cm} = 18\ \text{cm}$,故 A 正确。

  The time interval of 0~0.6s is $\Delta t = 0.6\ \text{s} = \frac{3}{4}T$. At t=0, particle P is at the wave crest (maximum displacement). In simple harmonic motion, the distance traveled by the particle starting from the wave crest in $\frac{3}{4}$ period is $3A$ (wave crest $\rightarrow$ equilibrium position $\rightarrow$ wave trough $\rightarrow$ equilibrium position, 3 amplitude distances in total). Substituting $A = 6\ \text{cm}$, the distance is $3 \times 6\ \text{cm} = 18\ \text{cm}$, so A is correct.

- 选项 B:t=0.6s 对应 $\frac{3}{4}T$,质点 P 从波峰开始运动,$\frac{3}{4}$ 周期后会到达平衡位置,此时相对平衡位置的位移为 0,并非 6cm,故 B 错误。

  t=0.6s corresponds to $\frac{3}{4}T$. Particle P starts moving from the wave crest, and after $\frac{3}{4}$ period, it will reach the equilibrium position, where the displacement relative to the equilibrium position is 0, not 6cm, so B is incorrect.

- 选项 C:t=1.2s 的时间间隔 $\Delta t = 1.2\ \text{s} = 1.5T$。t=0 时质点 Q 位于平衡位置,简谐运动中,加速度与位移成正比($a = -\frac{k}{m}x$),位移为 0 时加速度为 0(最小)。1.5T 后质点 Q 仍处于平衡位置,故加速度不是最大,C 错误。

  The time interval of t=1.2s is $\Delta t = 1.2\ \text{s} = 1.5T$. At t=0, particle Q is at the equilibrium position. In simple harmonic motion, acceleration is proportional to displacement ($a = -\frac{k}{m}x$), and the acceleration is 0 (minimum) when the displacement is 0. After 1.5T, particle Q is still at the equilibrium position, so the acceleration is not maximum, C is

incorrect.

- 选项 D:t=1.4s 的时间间隔 $\Delta t = 1.4\,s = 1.75T$ (即 $T + \frac{3}{4}T$)。t=0 时质点 M 的振动方向为 y 轴正方向(由"上下坡法"判断:波向右传, M 处于"下坡段", 振动方向向上); 经过 1.75T 后, 质点 M 到达波谷位置, 此时速度为 0, 并非沿 y 轴负方向运动, 故 D 错误。

  The time interval of t=1.4s is $\Delta t = 1.4\,s = 1.75T$ (i.e., $T + \frac{3}{4}T$). At t=0, the vibration direction of particle M is the positive y-axis direction (judged by the "uphill-downhill method": the wave propagates to the right, M is in the "downhill section", and the vibration direction is upward); after 1.75T, particle M reaches the wave trough position, where the velocity is 0, not moving along the negative y-axis direction, so D is incorrect.

第 23 题(Question 23)

题目:两个电阻的阻值分别为 3 欧和 6 欧, 下列说法正确的是(Two electrical resistors have resistances 3Ω and 6Ω respectively. Which of the following statements is correct?)

A. 串联时总电阻为 2 欧, 并联时总电阻为 2 欧(When connected in series, the total resistance is 2Ω; when connected in parallel, the total resistance is 2Ω)

B. 串联时总电阻为 9 欧, 并联时总电阻为 9 欧(When connected in series, the total resistance is 9Ω; when connected in parallel, the total resistance is 9Ω)

C. 串联时总电阻为 9 欧, 并联时总电阻为 2 欧(When connected in series, the total resistance is 9Ω; when connected in parallel, the total resistance is 2Ω)

D. 串联时总电阻为 2 欧, 并联时总电阻为 9 欧(When connected in series, the total resistance is 2Ω; when connected in parallel, the total resistance is 9Ω)

答案(Answer):C

解析(Explanation):

- 中文解析:

    1. 电阻串联(series connection):总电阻等于各电阻之和，公式 $R_{串} = R_1 + R_2$ ，代入数据得 $R_{串} = 3\,\Omega + 6\,\Omega = 9\,\Omega$ ；

    2. 电阻并联(parallel connection):总电阻的倒数等于各电阻倒数之和，公式 $\frac{1}{R_{并}} = \frac{1}{R_1} + \frac{1}{R_2}$ ，代入数据得 $\frac{1}{R_{并}} = \frac{1}{3\,\Omega} + \frac{1}{6\,\Omega} = \frac{1}{2\,\Omega}$ ，故 $R_{并} = 2\,\Omega$ 。

- English Explanation:

    1. Series connection of resistors: The total resistance is equal to the sum of each resistor, formula $R_{series} = R_1 + R_2$. Substituting the data, we get $R_{series} = 3\,\Omega + 6\,\Omega = 9\,\Omega$ ；

    2. Parallel connection of resistors: The reciprocal of the total resistance is equal to the sum of the reciprocals of each resistor, formula $\frac{1}{R_{parallel}} = \frac{1}{R_1} + \frac{1}{R_2}$. Substituting the data, we get $\frac{1}{R_{parallel}} = \frac{1}{3\,\Omega} + \frac{1}{6\,\Omega} = \frac{1}{2\,\Omega}$, so $R_{parallel} = 2\,\Omega$.

第 24 题(Question 24)
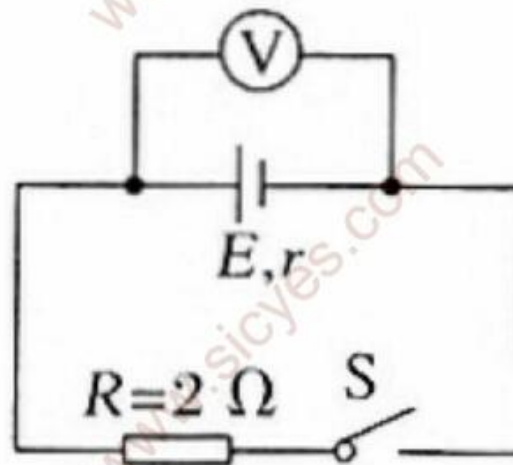
题目:如图所示的电路中，电阻 $R = 2\,\Omega$ ，断开开关 S 后，电压表的示数为 3 伏；闭合开关 S 后，电压表的示数为 2 伏，则电源的内阻 r 为(In the circuit shown in the figure, the resistor has $R = 2\,\Omega$. After disconnecting S, the voltmeter reading is 3V; after closing S, the voltmeter reading is 2V. So the internal resistance r of the power supply is)

A. 3Ω(3 欧，3 ohms)

B. 2Ω(2 欧，2 ohms)

C. 4Ω(4 欧，4 ohms)

D. 1Ω(1 欧，1 ohm)

答案(Answer):D

解析(Explanation):

- 中文解析:闭合电路欧姆定律(closed-circuit Ohm's law) $E = U + Ir$ (E 为电源电动势，U 为路端电压，I 为电路电流，r 为电源内阻):

  1. 断开开关 S 时，电路断路，路端电压等于电动势，即 $E = 3$,V ；

  2. 闭合开关 S 时，电压表测电阻 R 两端电压(路端电压 U=2V)，电路电流 $I = \frac{U}{R} = \frac{2,V}{2,\Omega} = 1$,A ；

  3. 代入闭合电路欧姆定律 $E = U + Ir$ ，得 3,V $= 2$,V $+ 1$,A $\times r$ ，解得 $r = 1,\Omega$ 。

- English Explanation:Closed-circuit Ohm's law $E = U + Ir$ (E is the electromotive force of the power supply, U is the terminal voltage, I is the circuit current, r is the internal resistance of the power supply):

  1. When switch S is disconnected, the circuit is open, and the terminal voltage is equal to the electromotive force, i.e., $E = 3$,V ；

  2. When switch S is closed, the voltmeter measures the voltage across resistor R (terminal voltage U=2V), and the circuit current $I = \frac{U}{R} = \frac{2,V}{2,\Omega} = 1$,A ；

  3. Substituting into closed-circuit Ohm's law $E = U + Ir$, we get 3,V $= 2$,V $+ 1$,A $\times r$, so $r = 1,\Omega$.

第 25 题(Question 25)

题目:一个气球内充有理想气体，当气球上升时，假设气体体积保持不变，温度降低，则在此过程中气球内的理想气体(A balloon is filled with ideal gas. When the balloon rises, assume that the volume of the gas remains constant, and the temperature decreases. In this process the ideal gas in the balloon would)

    A. 吸热(Absorb heat)

    B. 压强增大(Increase pressure)

    C. 内能减小(Decrease internal energy)

    D. 对外做负功(Do negative work to outside)

答案(Answer):C

解析(Explanation):

- 中文解析:理想气体的内能仅由温度决定(内能与分子平均动能成正比，温度是平均动能的标志)。体积不变时，气体不对外做功也不对外界做功(W=0)；温度降低，分子平均动能减小，内能减小。根据热力学第一定律 ΔU=Q+W，ΔU 为负、W=0，故 Q 为负，气体放热。由查理定律(体积不变时，压强与热力学温度成正比)，温度降低则压强减小。

- English Explanation:The internal energy of an ideal gas depends only on temperature (internal energy is proportional to the average kinetic energy of molecules, and temperature is a measure of average kinetic energy). When the volume is constant, the gas does no work on the outside and no work is done on it (W=0); a decrease in temperature reduces the average kinetic energy of molecules, leading to a decrease in internal energy. According to the first law of thermodynamics ΔU=Q+W, with ΔU negative and W=0, Q is negative, meaning the gas releases heat. By Charles's Law (when

volume is constant, pressure is proportional to thermodynamic temperature), a decrease in temperature results in a decrease in pressure.

第 26 题(Question 26)

题目:一个物体竖直上抛上升过程中，重力对物体做功−70 焦耳，不计空气阻力，下列说法正确的是(During the ascent of an object being thrown vertically upwards, gravity does −70J of work on the object. Ignoring air resistance, which of the following statements is correct?)

A. 重力势能减少 70 焦耳(The gravitational potential energy decreases by 70J)

B. 重力势能增加 70 焦耳(The gravitational potential energy increases by 70J)

C. 机械能减少 70 焦耳(The mechanical energy decreases by 70J)

D. 重力势能保持不变(The gravitational potential energy remains constant)

答案(Answer):B

解析(Explanation):

- 中文解析:重力做功与重力势能变化的关系为 $W_G = -\Delta E_p$ (重力做正功,重力势能减小;重力做负功，重力势能增大)。重力做功−70J，故重力势能增加 70J。不计空气阻力时，只有重力做功，机械能守恒(动能与重力势能相互转化，总机械能不变)。

- English Explanation:The relationship between work done by gravity and changes in gravitational potential energy is $W_G = -\Delta E_p$ (positive work done by gravity reduces gravitational potential energy; negative work done by gravity increases gravitational potential energy). Gravity does −70J of work, so gravitational potential energy increases by 70J. Ignoring air resistance, only gravity does work, and mechanical energy is conserved (kinetic energy and gravitational potential energy convert to each other, with total mechanical energy unchanged).

第 27 题(Question 27)

题目:若通过一根导线的电流为 1.6 安，则 0.5 秒内通过导线横截面的电荷量为(If the current passing through a wire is 1.6A, the amount of charge passing through the cross-section of the wire within 0.5s is)

    A. 1.6C(1.6 库仑，1.6 coulombs)

    B. 1.2C(1.2 库仑，1.2 coulombs)

    C. 2.0C(2.0 库仑，2.0 coulombs)

    D. 0.8C(0.8 库仑，0.8 coulombs)

答案(Answer):D

解析(Explanation):

- 中文解析:电流的定义式为 $I = \frac{q}{t}$ (I 为电流，q 为电荷量，t 为时间)，变形得 $q = It$ 。代入数据 $I = 1.6\,A$ 、 $t = 0.5\,s$ ，得 $q = 1.6\,A \times 0.5\,s = 0.8\,C$ 。

- English Explanation:The definition of current is $I = \frac{q}{t}$ (I is current, q is charge, t is time), which rearranges to $q = It$. Substituting the data $I = 1.6\,A$ and $t = 0.5\,s$, we get $q = 1.6\,A \times 0.5\,s = 0.8\,C$.

第 28 题(Question 28)

题目:一定质量的理想气体，温度保持不变，压强减小，则其体积会(A certain mass of ideal gas, with its temperature kept constant and pressure reduced, its volume would)

    A. 选项均有可能(All options above are possible)

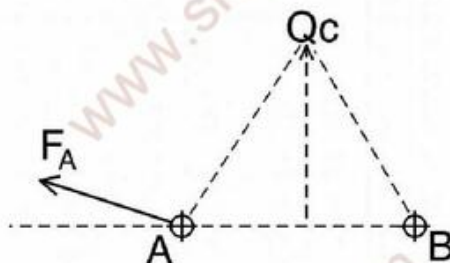   B. 增大(Increase)

    C. 减小(Decrease)

D. 保持不变(Remain unchanged)

答案(Answer):B

解析(Explanation):

- 中文解析:一定质量的理想气体在等温过程中遵循玻意耳定律(Boyle's Law): $pV = C$ (p 为压强，V 为体积，C 为常量)。该定律表明，温度不变时，压强与体积成反比。因此，压强减小时，体积必然增大。

- English Explanation:A certain mass of ideal gas follows Boyle's Law in an isothermal process: $pV = C$ (p is pressure, V is volume, C is a constant). This law states that at constant temperature, pressure is inversely proportional to volume. Therefore, when pressure decreases, volume must increase.

第 29 题(Question 29)

题目:三个点电荷 A、B、C 位于等边三角形的三个顶点，A、B 均带正电，电荷 B、C 对 A 的静电力的合力 $\vec{F_A}$ 如图所示，已知 $\vec{F_A}$ 与 BA 的延长线的夹角小于 60°，则关于电荷 C 的正确判断是(Three point charges A, B, and C are located at the vertices of an equilateral triangle, with both A and B carrying positive charges. The resultant forces of the electrostatic forces of the two charges B and C acting on A is shown as $\vec{F_A}$ in the figure. Given that the angle between $\vec{F_A}$ and

the extension line of BA is less than 60°, what is the correct judgment about the charge at C?)

A. 带正电，电荷量小于 B(Positively charged, charge amount less than B)

B. 带负电，电荷量大于 B(Negatively charged, charge amount greater than B)

C. 带正电，电荷量大于 B(Positively charged, charge amount greater than B)

D. 带负电，电荷量小于 B(Negatively charged, charge amount less than B)

答案(Answer):D

解析(Explanation):

中文解析:结合示意图(等边三角形，A、B、C 为顶点)，核心受力分析如下，逐一解析选项:

1. 选项 A、C(C 带正电):A、B 均带正电，若 C 带正电，则 C 对 A 的静电力为斥力(沿 CA 延长线向外)；B 对 A 的静电力也为斥力(沿 BA 延长线向外)，两斥力的合力与 BA 延长线的夹角必大于等于 60°，与题干"夹角小于 60°"矛盾，故 A、C 错误;

2. 选项 B(C 带负电、电荷量大于 B):C 带负电时，C 对 A 的静电力为引力(沿 AC 方向指向 C);若 C 电荷量大于 B，则 C 对 A 的引力 $F_{CA} > F_{BA}$ (B 对 A 的斥力)，根据平行四边形定则，合力与 BA 延长线的夹角会大于 60°，不符合题干条件，故 B 错误;

3. 选项 D(C 带负电、电荷量小于 B):C 带负电，C 对 A 的静电力为引力(沿 AC 指向 C);若 C 电荷量小于 B，则 $F_{CA} < F_{BA}$ ，结合平行四边形定则，合力 $\vec{F_A}$ 与 BA 延长线的夹角小于 60°，与题干完全一致，故 D 正确。

English Explanation: Combined with the schematic diagram uploaded (equilateral triangle with A, B, C as vertices), the core force analysis is as follows, and each option is analyzed one by one:

1. Options A and C (C is positively charged): Both A and B are positively charged. If C is positively charged, the electrostatic force exerted by C on A is a repulsive force (outward along the extension of CA); the electrostatic force exerted by B on A is also a repulsive force (outward along the extension of BA). The resultant force of the two repulsive forces must be greater than or equal to 60° with the extension of BA, which contradicts the question's "angle less than 60°",

so A and C are incorrect;

2. Option B (C is negatively charged, charge amount greater than B): When C is negatively

charged, the electrostatic force exerted by C on A is an attractive force (pointing to C along AC);

if the charge of C is greater than that of B, the attractive force $F_{CA} > F_{BA}$ (repulsive force

exerted by B on A). According to the parallelogram rule, the angle between the resultant force

and the extension of BA will be greater than 60°, which does not meet the question conditions,

so B is incorrect;

3. Option D (C is negatively charged, charge amount less than B): C is negatively charged,

and the electrostatic force exerted by C on A is an attractive force (pointing to C along AC); if

the charge of C is less than that of B, then $F_{CA} < F_{BA}$. Combined with the parallelogram rule,

the angle between the resultant force $\overrightarrow{F_A}$ and the extension of BA is less than 60°, which is

completely consistent with the question, so D is correct.

第 30 题(Question 30)
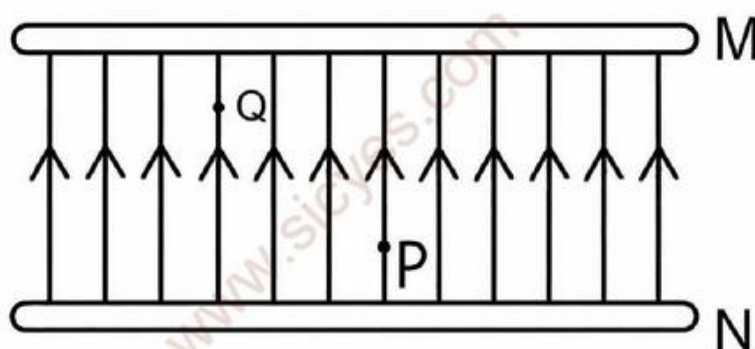
题目:如图所示，两个带等量异种电荷的平行金属板 M、N 水平放置，两板间的电场线是间隔

相等的平行线，P、Q 是电场中的两个点，下列说法正确的是(As shown in the figure, two parallel

metal plates M and N with equal and opposite charges are placed horizontally. The electric field

lines between them are parallel lines with equal intervals, and P and Q are two points in the electric field. Which of the following statements is correct?)

A. M 带正电，N 带负电(M has positive charge, N has negative charge)

B. P、Q 两点的场强大小相等(P, Q have equal field strength)

C. P、Q 两点的电势和场强均不同(Both the electrical potential and field strength at P, Q are different)

D. P、Q 两点的电势相等(P, Q have equal electrical potential)

答案(Answer):B

解析(Explanation):

- 中文解析:

  1. 电场类型判断:电场线平行且间隔相等，说明两板间为匀强电场(uniform electric field);

  2. 场强特点:匀强电场中各点场强大小和方向均相同，故 P、Q 两点场强相等(选项 B 正确，C 错误);

  3. 电势判断:沿电场线方向电势逐渐降低，P、Q 不在同一等势面(equipotential surface)，故电势不同(选项 D 错误);

  4. 极板带电判断:无电场线方向标注，无法确定 M、N 的带电正负(选项 A 错误)。

- English Explanation:

  1. Electric field type judgment: Parallel and equally spaced electric field lines indicate a uniform electric field between the plates;

  2. Electric field strength characteristics: In a uniform electric field, the magnitude and direction of electric field strength are the same at all points, so the field strengths at P and Q are equal (Option B is correct, C is incorrect);

3. Electric potential judgment: Electric potential decreases gradually along the direction of electric field lines. P and Q are not on the same equipotential surface, so their potentials are different (Option D is incorrect);

4. Plate charge judgment: Without the direction of electric field lines marked, the positive and negative charges of M and N cannot be determined (Option A is incorrect).

第 31 题(Question 31)

题目:一根长度 $L = 0.5,m$ 、通有电流 $I = 2,A$ 的直导线放在磁感应强度 $B = 0.4,T$ 的匀强磁场中，磁场方向与导线中电流方向的夹角为 30°，则导线受到的安培力大小为(A straight wire with length $L = 0.5,m$ and a current of $I = 2,A$ is placed in a uniform magnetic field with a magnetic induction intensity of $B = 0.4,T$. The angle between the direction of the magnetic field and the direction of the current in the wire is 30 degrees. The ampere force acting on the wire is)

A. 0.4N(0.4 牛，0.4 newtons)

B. 0N(0 牛，0 newtons)

C. 0.2N(0.2 牛，0.2 newtons)

D. $\frac{\sqrt{3}}{5}$,N（$\frac{\sqrt{3}}{5}$,牛）

答案(Answer):C

解析(Explanation):

- 中文解析:安培力公式为 $F = BILsin\theta$（θ 为磁场与电流方向的夹角）。代入数据 $B = 0.4,T$、$I = 2,A$、$L = 0.5,m$、$sin30° = 0.5$，得 $F = 0.4,T \times 2,A \times 0.5,m \times 0.5 = 0.2,N$。

- English Explanation:The formula for Ampere force is $F = BILsin\theta$ (θ is the angle between the magnetic field and the current direction). Substituting the data $B = 0.4$,T , $I = 2$,A , $L = 0.5$,m , and $sin30° = 0.5$, we get $F = 0.4$,T $\times 2$,A $\times 0.5$,m $\times 0.5 = 0.2$,N .

第 32 题(Question 32)

题目:在磁感应强度 $B = 0.8$,T 的匀强磁场中，一个矩形线圈的面积 $S = 0.5$,m² ，线圈平面的法线方向与磁场方向的夹角为 60°，则穿过线圈的磁通量大小为(In a uniform magnetic field with a magnetic induction intensity of $B = 0.8$,T , a rectangular coil has area $S = 0.5$,m² , and the angle between the normal direction of the coil plane and the direction of the magnetic field is 60 degrees. Therefore, the magnitude of the magnetic flux passing through the coil is)

A. 0.2Wb(0.2 韦伯， 0.2 webers)

B. 0.8Wb(0.8 韦伯， 0.8 webers)

C. 0.4Wb(0.4 韦伯， 0.4 webers)

D. 0.6Wb(0.6 韦伯， 0.6 webers)

答案(Answer):A

解析(Explanation):

- 中文解析:磁通量(magnetic flux)的定义式为 $\Phi = BScos\theta$ (θ 为线圈法线方向与磁场方向的夹角)。代入数据 $B = 0.8$,T 、 $S = 0.5$,m² 、 $cos60° = 0.5$ ，得 $\Phi = 0.8$,T $\times 0.5$,m² $\times 0.5 = 0.2$,Wb 。

- English Explanation:The definition of magnetic flux is $\Phi = BScos\theta$ (θ is the angle between the normal direction of the coil plane and the magnetic field direction). Substituting the data $B = 0.8$,T , $S = 0.5$,m² , and $cos60° = 0.5$, we get $\Phi =$

$0.8, T \times 0.5, m^2 \times 0.5 = 0.2, Wb$.

第 33 题(Question 33)

题目:如图所示，在一根通有图示方向电流 I 的长直导线右侧，固定一个矩形金属线框 abcd，其边 bc 与导线平行。通过调节电流 I，使空间各点的磁感应强度随时间均匀增大，则(As shown in the figure, on the right side of a long straight wire with a current I flowing in the direction indicated in the diagram, a rectangular metal wire frame abcd is fixed, with its side ad parallel to the wire. By adjusting the current I, the magnetic induction intensity at each point in space increases uniformly over time. Then,)
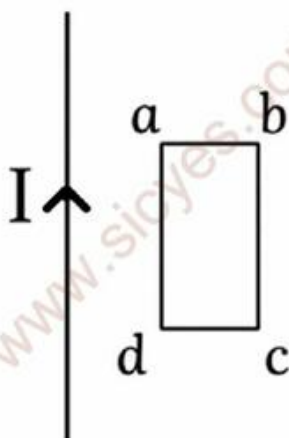
A. 线框中感应电流的方向为 a→b→c→d→a (The induced current in the frame has direction a→b→c→d→a)

B. 线框中的感应电流逐渐增大(The induced current in the frame gradually increases)

C. 线框受到水平向右的安培力(The frame experiences an ampere force horizontally towards the right)

D. 边 bc 受到的安培力大小不变(The ampere force acting on the edge cd is constant)

答案(Answer):C

解析(Explanation):

中文解析:核心知识点:安培定则、楞次定律、法拉第电磁感应定律,逐一解析选项:

1. 选项 A(感应电流方向):由安培定则可知,长直导线右侧磁场方向垂直纸面向里;磁感应强度均匀增大,线框内磁通量向里增大。根据楞次定律,感应电流的磁场要阻碍磁通量增大,故感应电流磁场方向垂直纸面向外;再由安培定则,线框中感应电流方向为 a→d→c→b→a,而非 a→b→c→d→a,A 错误;

2. 选项 B(感应电流大小):磁感应强度随时间均匀增大,即 $\Delta B/\Delta t$ 恒定;线框面积 S 不变,由法拉第电磁感应定律,感应电动势 $E=\Delta\Phi/\Delta t=\Delta B/\Delta t\cdot S$($\Phi$ 为磁通量),E 恒定;线框电阻不变,由欧姆定律 $I=E/R$,感应电流大小不变,B 错误;

3. 选项 C(线框安培力方向):根据楞次定律的推论,感应电流的效果总是阻碍引起感应电流的原因(磁通量增大);线框要阻碍磁通量增大,会向磁场较弱的右侧运动,故线框受到的安培力方向水平向右(贴合示意图磁场分布,导线右侧磁场越远越弱),C 正确;

4. 选项 D(cd 边安培力大小):安培力公式 $F=BIL$,bc 边电流 I 恒定、长度 L 不变;但磁感应强度 B 随时间均匀增大,故 bc 边受到的安培力逐渐增大,而非不变,D 错误。

English Explanation: The core knowledge points: Ampere's rule, Lenz's law, Faraday's law of electromagnetic induction. Analyze each option one by one:

1. Option A (direction of induced current): According to Ampere's rule, the magnetic field direction on the right side of the long straight wire is perpendicular to the paper inward; the magnetic induction intensity increases uniformly, and the magnetic flux in the wire frame increases inward. According to Lenz's law, the magnetic field of the induced current will hinder the increase of magnetic flux, so the direction of the induced current's magnetic field is perpendicular to the paper outward; then by Ampere's rule, the direction of the induced current in the wire frame is a→d→c→b→a, not a→b→c→d→a, A is incorrect;

2. Option B (magnitude of induced current): The magnetic induction intensity increases uniformly with time, that is, $\Delta B/\Delta t$ is constant; the area S of the wire frame is unchanged. According to Faraday's law of electromagnetic induction, the induced electromotive force $E=\Delta\Phi/\Delta t=\Delta B/\Delta t\cdot S$ (Φ is magnetic flux), so E is constant; the resistance of the wire frame is unchanged, and by Ohm's law $I=E/R$, the magnitude of the induced current is constant, B is incorrect;

3. Option C (direction of Ampere force on the wire frame): According to the corollary of Lenz's law, the effect of the induced current always hinders the cause of the induced current (increase of magnetic flux); the wire frame will move to the right where the magnetic field is weaker to hinder the increase of magnetic flux, so the direction of the Ampere force on the wire frame is horizontally to the right (consistent with the magnetic field distribution in the schematic diagram, the magnetic field on the right side of the wire is weaker as it is farther away), C is correct;

4. Option D (magnitude of Ampere force on side cd): The Ampere force formula is $F=BIL$. The current I and length L of side bc are constant; but the magnetic induction intensity B increases uniformly with time, so the Ampere force on side bc gradually increases, not constant, D is incorrect.

第 34 题(Question 34)

题目:如图所示，空间存在一个电场，a、b 为电场中的两个点，下列说法正确的是(As shown in the figure, there is an electric field in space with two points a and b. Which of the following

statements is correct?)

A. b 点的电场强度大于 a 点(The electric field strength at point b is greater than that at point a)

B. a 点的电场强度大于 b 点(The electric field strength at point a is greater than that at point b)

C. 该电场为匀强电场(This electric field is a uniform electric field)

D. a、b 两点的电场强度大小相等(The electric field strength at points a and b is the same)

答案(Answer):B
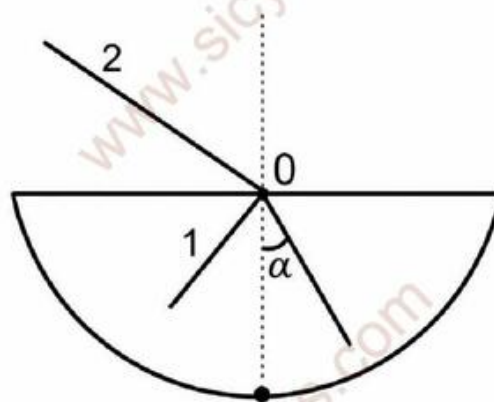
解析(Explanation):

- 中文解析:电场线的疏密程度反映电场强度的大小(electric field strength is reflected by the density of electric field lines)。由图可知，a 点的电场线比 b 点密集，故 a 点的电场强度大于 b 点(选项 B 正确，A、D 错误)。匀强电场的电场线是平行等距的直线，图中电场线分布不满足该特征(选项 C 错误)。

- English Explanation:The density of electric field lines reflects the magnitude of electric

field strength. It can be seen from the figure that the electric field lines at point a are denser than those at point b, so the electric field strength at point a is greater than that at point b (Option B is correct, A and D are incorrect). The electric field lines of a uniform electric field are parallel and equally spaced straight lines, and the distribution of electric field lines in the figure does not meet this characteristic (Option C is incorrect).

第 35 题(Question 35)

题目:如图所示，一个玻璃圆柱的横截面为半圆形，一束单色细光沿圆柱射向半圆的圆心 O，入射角 $\alpha = 30°$，产生的反射光 1 和折射光 2 恰好垂直，则玻璃的折射率为(As shown in the figure, the cross-section of a glass cylinder is semi-circular. A thin monochromatic beam travels through the cylinder towards the center of the semicircle O at an incident angle of $\alpha = 30°$.

The reflected beam 1 and refracted beam 2 produced are exactly perpendicular to each other. Therefore, the refractive index of the glass is)

A. $\sqrt{3}$

B. $\sqrt{2}$

C. $\frac{1}{\sqrt{3}}$

D. $\frac{\sqrt{3}}{2}$
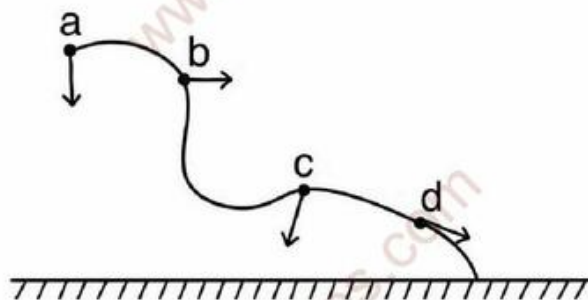
答案(Answer):A

解析(Explanation):

- 中文解析:

  1. 反射定律:反射角等于入射角，故反射角 $\alpha' = 30°$；

  2. 折射角计算:反射光与折射光垂直，故反射光与折射光的夹角为 $90°$,结合几何关系，折射角 $\gamma = 90° - 30° = 60°$；

  3. 折射定律:光从空气(折射率 $n_1 = 1$)射入玻璃，由 $n_1\sin\alpha = n_2\sin\gamma$ ，得 $n_2 = \frac{\sin\alpha}{\sin\gamma} = \frac{\sin30°}{\sin60°} = \frac{0.5}{\frac{\sqrt{3}}{2}} = \sqrt{3}$ 。

- English Explanation:

  1. Law of reflection: The angle of reflection is equal to the angle of incidence, so the angle of reflection $\alpha' = 30°$；

  2. Refraction angle calculation: The reflected beam and refracted beam are perpendicular, so the angle between them is $90°$. Combined with geometric relations, the refraction angle $\gamma = 90° - 30° = 60°$；

  3. Snell's Law: Light enters glass from air (refractive index $n_1 = 1$). From $n_1\sin\alpha = n_2\sin\gamma$, we get $n_2 = \frac{si}{\sin\gamma} = \frac{\sin30°}{\sin60°} = \frac{0.5}{\frac{\sqrt{3}}{2}} = \sqrt{3}$.

第 36 题(Question 36)

题目:如图所示，一片树叶从空中下落的轨迹如图，图中标记了树叶在 a、b、c、d 四个位置

的速度方向，其中正确的是(The trajectory of a leaf falling from the air is shown in the figure, the velocity directions of the leaf at positions a, b, c, and d are indicated. The correct direction is)
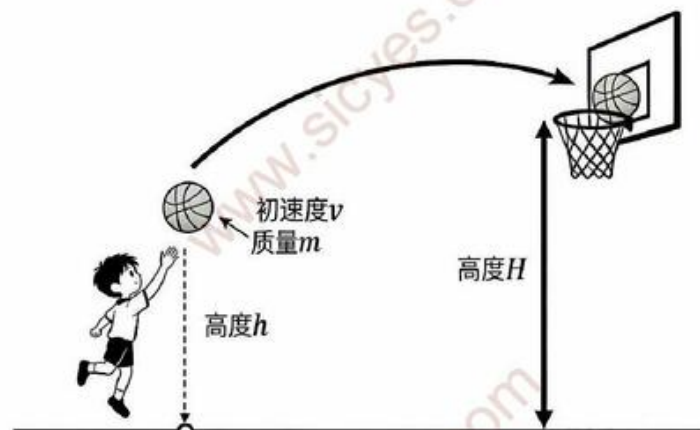
A. a

B. b

C. c

D. d

答案(Answer):D

解析(Explanation):

中文解析核心知识点:物体做曲线运动时，瞬时速度方向始终沿轨迹在该点的切线方向，这是曲线运动的核心规律。

English The core knowledge point: when an object moves in curvilinear motion, the instantaneous velocity direction is always along the tangent direction of the trajectory at that point, which is the core law of curvilinear motion.

第 37 题(Question 37)

题目:如图所示，一名学生将质量为 m 的篮球从高度 h 处以初速度 v 抛出，篮球恰好进入高度

为 H 的篮筐。以地面为零势能面，不计空气阻力，重力加速度大小为 g，则篮球进入篮筐时的

机械能为(As shown in the figure, a student throws a basketball with a mass of m from a height of h at an initial velocity of v, and the basketball just enters the basket with a height of H above the ground. Taking the ground as the zero potential energy surface, ignoring air resistance, and let the magnitude of gravitational acceleration be g, the mechanical energy of the basketball entering the basket is)

A. $\frac{1}{2}mv^2 + mgH$

B. $\frac{1}{2}mv^2 + mg(H - h)$

C. $\frac{1}{2}mv^2 + mgh$

D. $\frac{1}{2}mv^2 + mgH + mg(H - h)$

答案(Answer):C

解析(Explanation):

- 中文解析:不计空气阻力时，篮球只受重力做功，机械能守恒(mechanical energy is conserved)，即抛出时的机械能等于进入篮筐时的机械能。抛出时的机械能为动能与重力势能之和: $E = \frac{1}{2}mv^2 + mgh$ ，故进入篮筐时的机械能仍为该值(选项 C 正确)。

- English Explanation: Ignoring air resistance, only gravity does work on the basketball, so mechanical energy is conserved, meaning the mechanical energy at the time of throwing is equal to that when entering the basket. The mechanical energy at the time of throwing is the sum of kinetic energy and gravitational potential energy: $E = \frac{1}{2}mv^2 + mgh$, so the mechanical energy when entering the basket is still this value (Option C is correct).

第 38 题(Question 38)

题目:一辆质量为 2 吨的汽车，发动机功率为 30 千瓦，在水平地面上以 72 千米/时的速度匀速

行驶，则汽车在该路面行驶时受到的阻力为(A car with a mass of 2 tons and an engine with a power of 30kW travels at a constant velocity of 72km/h on a level ground. The resistance experienced by the car while driving on that road is)

A. 5×10^3,N（5×10^3,牛）

B. 6×10^3,N（6×10^3,牛）

C. 1.5×10^3,N（1.5×10^3,牛）

D. 2×10^3,N（2×10^3,牛）

答案(Answer):C

解析(Explanation):

- 中文解析:

  1. 单位统一:72km/h = 20m/s，30kW = 30000W;

  2. 功率公式:汽车匀速行驶时，牵引力 F 与阻力 f 平衡(F = f)，发动机功率 $P = Fv = fv$;

  3. 阻力计算: $f = \frac{P}{v} = \frac{30000,W}{20,m/s} = 1500,N = 1.5 \times 10^3$,N 。

- English Explanation:

  1. Unit unification: 72km/h = 20m/s, 30kW = 30000W;

  2. Power formula: When the car travels at a constant speed, the traction force F balances the resistance f (F = f), and the engine power $P = Fv = fv$;

  3. Resistance calculation: $f = \frac{P}{v} = \frac{30000,W}{20,m/s} = 1500,N = 1.5 \times 10^3$,N .

第 39 题(Question 39)

题目:一个小球从某一高度以初速度 v_0 水平抛出，落到水平地面上。随后在同一高度以初速度 $2v_0$ 再次水平抛出,落到同一地面,不计空气阻力,则第二次抛出时(A ball is thrown horizontally

from a certain height at an initial velocity of v_0 and it lands on a level ground. Then, the ball is thrown again at the same height horizontally at an initial velocity of $2v_0$ and it lands on the same ground. Ignoring air resistance, during the second throw of the ball,)

A. 水平位移变为原来的 2 倍(The horizontal displacement becomes twice of the original)

B. 下落时间变为原来的 2 倍(The time taken to fall becomes twice of the original)

C. 水平位移变为原来的 1/2(The horizontal displacement becomes half of the original)

D. 下落时间变为原来的 1/2(The time taken to fall becomes half of the original)

答案(Answer):A

解析(Explanation):

- 中文解析:

1. 下落时间:平抛运动的竖直方向为自由落体运动，下落时间由高度决定，$t = \sqrt{\frac{2h}{g}}$。两次抛出高度相同，故下落时间不变(选项 B、D 错误);

2. 水平位移:水平方向为匀速直线运动，位移 $x = v_0 t$。第二次初速度为 $2v_0$，时间 t 不变，故水平位移变为原来的 2 倍(选项 A 正确，C 错误)。

- English Explanation:

1. Falling time: The vertical direction of projectile motion is free fall, and the falling time is determined by the height, $t = \sqrt{\frac{2h}{g}}$. The throwing height is the same twice, so the falling time is unchanged (Options B and D are incorrect);

2. Horizontal displacement: The horizontal direction is uniform linear motion, and the displacement $x = v_0 t$. The initial velocity is $2v_0$ for the second time, and the time t is unchanged, so the horizontal displacement becomes twice the original (Option A is correct, C is incorrect).

题目:如图所示，两个质量相等的物体 A、B 放在绕竖直轴匀速转动的水平圆盘上，且两物体相对圆盘静止，则(As shown in the figure, if two objects A and B with equal mass are placed on a horizontal disk rotating uniformly around the vertical axis, and the two objects remain stationary
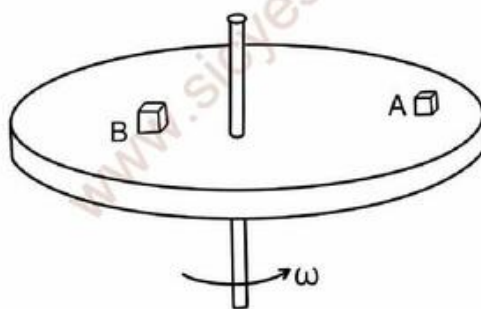
relative to the disk, then)

A. A 的角速度与 B 的角速度相等(The angular velocity of A is the same as B)

B. A 的线速度与 B 的线速度相等(The linear velocity of A is the same as B)

C. A 的角速度大于 B 的角速度(The angular velocity of A is greater than that of B)

D. A 的角速度小于 B 的角速度(The angular velocity of A is smaller than that of B)

答案(Answer):A

解析(Explanation):

- 中文解析:A、B 随圆盘一起绕竖直轴匀速转动，属于共轴转动(coaxial rotation)。共轴转动的物体具有相同的角速度(angular velocity)，故选项 A 正确，C、D 错误。线速度 $v = \omega r$ (r 为转动半径)，若 A、B 到转轴的距离不同，则线速度不同(选项 B 错误)。

- English Explanation:A and B rotate uniformly around the vertical axis with the disk, which is a coaxial rotation. Objects in coaxial rotation have the same angular velocity, so Option A is correct, and C and D are incorrect. The linear velocity $v = \omega r$ (r is the rotation

radius). If the distances from A and B to the rotating axis are different, their linear

velocities are different (Option B is incorrect).

第 41 题(Question 41)

题目:一个质量为 m 的物体从静止开始自由下落，不计空气阻力，经过时间 t 时重力对物体做

功的功率为(An object with mass m falls freely from rest. Ignoring air resistance, the power

delivered by gravity on the object over time t is)

A. $\frac{1}{2}mg^2t$

B. mgt

C. mg^2t
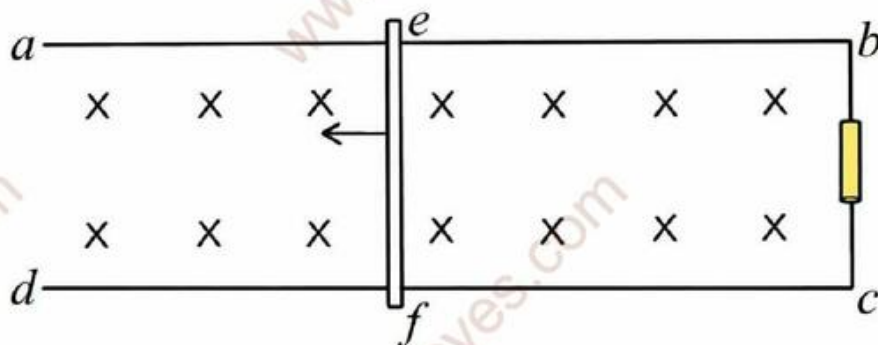
D. $\frac{1}{4}mgt$

答案(Answer):C

解析(Explanation):

- 中文解析:

    1. 自由下落的速度: $v = gt$ (由 $v = v_0 + gt$ ，初速度 $v_0 = 0$);

    2. 功率公式:重力的瞬时功率 $P = Fv\cos\theta$ ，重力与速度方向相同($\theta = 0°$ ， $\cos 0° = 1$)，故 $P = mgv = mg \cdot gt = mg^2t$ 。

- English Explanation:

    1. Velocity of free fall: $v = gt$ (from $v = v_0 + gt$, initial velocity $v_0 = 0$);

    2. Power formula: The instantaneous power of gravity $P = Fv\cos\theta$. The direction of gravity is the same as the direction of velocity ($\theta = 0°$, $\cos 0° = 1$), so $P = mgv = mg \cdot gt = mg^2t$.

如图所示，连接负载的固定 U 型金属导轨 abcd，放置在与导轨平面垂直的匀强磁场中。导轨上有一根可自由滑动的金属棒 ef，在金属棒向左平移的过程中。下列说法正确的是(As shown in the figure, a fixed U-shaped metallic rail abcd connected with a load is placed in a uniform magnetic field perpendicular to the plane of the rail. There is a freely slidable metal rod ef on the rail. During the leftward translation of the metal rod, which of the following statements is correct?)

A. 穿过 ebcf 回路的磁通量不变(The magnetic flux passing through the ebcf loop remains unchanged)

B. 穿过 ebcf 回路的磁通量变小(The magnetic flux passing through the ebcf loop decreases)

C. ae 段有电流通过(There is a current flowing through segment ae)

D. bc 段有电流通过(There is a current flowing through segment bc)

答案(Answer)D

解析(Explanation)

核心原理分析(Analysis of core principles)

本题核心考查磁通量变化判断及感应电流的产生条件，结合配图和题干条件分析如下，核心依据为:

1. 磁通量(Magnetic Flux):磁通量公式为 $\Phi = B \cdot S$（B 为匀强磁场的磁感应强度，恒定不变；S 为 ebcf 回路的有效面积）。金属棒 ef 向左平移时，ebcf 回路的有效面积 S 逐渐变大，因此穿过该回路的磁通量随之变大。

2. 感应电流产生条件(Condition for Induced Current Generation):闭合回路 + 穿过回路的磁通量发生变化，二者缺一不可；感应电流仅在闭合回路内流动，非闭合回路部分无感应电流。

This question focuses on the judgment of magnetic flux change and the generation conditions of induced current, which are analyzed as follows combined with the figure and the question conditions. The core basis is:

1. Magnetic Flux: The formula of magnetic flux is $\Phi = B \cdot S$ (B is the magnetic induction intensity of the uniform magnetic field, which is constant; S is the effective area of the ebcf loop). When the metal rod ef translates to the left, the effective area S of the ebcf loop gradually increases, so the magnetic flux passing through the loop increases accordingly.

2. Condition for Induced Current Generation: Closed loop + the magnetic flux passing through the loop changes, both are indispensable; the induced current only flows in the closed loop, and there is no induced current in the non-closed loop part.

选项分析(Analysis of options)

- 选项 A:由磁通量公式 $\Phi = B \cdot S$ 可知，金属棒左移时 ebcf 回路面积变大，磁感应强度 B 恒定，因此磁通量变大，并非保持不变，A 错误。According to the magnetic flux formula $\Phi = B \cdot S$, the area of the ebcf loop increases when the metal rod moves to the left, and the magnetic induction intensity B is constant, so the magnetic flux increases instead of

remaining unchanged, A is incorrect.

- 选项 B:结合核心原理分析，ebcf 回路面积随金属棒左移而变大，磁通量随之变大，并非变小，B 错误。Combined with the analysis of core principles, the area of the ebcf loop increases with the leftward movement of the metal rod, and the magnetic flux increases accordingly, not decreases, B is incorrect.

- 选项 C:感应电流仅在闭合回路内流动，ae 段不属于 ebcf 闭合回路的一部分，因此 ae 段没有电流通过，C 错误。The induced current only flows in the closed loop, and segment ae is not part of the ebcf closed loop, so there is no current passing through segment ae, C is incorrect.

- 选项 D:ebcf 构成闭合回路，且金属棒左移时穿过该回路的磁通量变大，满足感应电流的产生条件，因此回路中有感应电流产生；bc 段是该闭合回路的一部分，故 bc 段有电流通过，D 正确。ebcf forms a closed loop, and the magnetic flux passing through the loop increases when the metal rod moves to the left, which meets the condition for generating induced current. Therefore, an induced current is generated in the loop; segment bc is part of the closed loop, so there is current passing through segment bc, D is correct.

总结(Summary)

判断磁通量变化的关键是分析公式 $\Phi = B \cdot S$ 中"有效面积 S"和"磁感应强度 B"的变化；判断感应电流是否存在，需同时满足"闭合回路"和"磁通量变化"两个条件。The key to judging the change of magnetic flux is to analyze the changes of "effective area S" and "magnetic induction intensity B" in the formula $\Phi = B \cdot S$; to judge whether an induced current exists, two conditions must be met simultaneously: "closed loop" and "magnetic flux change".

第 43 题(Question 43)
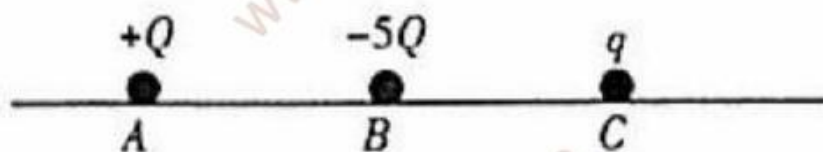
题目:如图所示，两个相同的金属球(均可视为点电荷)固定在真空中的 A、B 两点，电荷量分别为 $+Q$ 和 $-5Q$ ，在 A、B 的延长线上有一点 C，固定一个点电荷 q，该电荷受到的静电力大小为 F_1 ，已知 $AB = BC$ 。若将两个带电金属球接触后再放回原处，则点电荷 q 受到的静电力大小变为 F_2 ，则 $\frac{F_1}{F_2}$ 为(As shown in the figure, two identical metal balls (both of which can be considered as point charges) are fixed at points A and B in vacuum, with charges of $+Q$ and $-5Q$, respectively. A point charge q is fixed at point C on the line extending from A to B. The magnitude of the electrostatic force acting on this charge is F_1 . It is given that $AB = BC$. If the two charged metal balls are brought into contact and then returned to their original positions, the magnitude of the electrostatic force acting on charge q becomes F_2 . Thus, $\frac{F_1}{F_2}$ is)

A. $\frac{21}{10}$

B. $\frac{21}{16}$

C. $\frac{19}{10}$

D. $\frac{19}{16}$

答案(Answer):C

解析(Explanation):

设 AB=BC=l，试探电荷为正电荷，根据库仑定律和电荷分配规律，计算如下:

Let AB=BC=l and the test charge be a positive charge. The calculation is as follows according to Coulomb's Law and the charge distribution rule:

1. 计算 F₁(Calculate F₁):

A 点电荷(+Q)对 q 的静电力: $F_A = k\frac{Qq}{(2l)^2} = k\frac{Qq}{4l^2}$ (斥力向右);

B 点电荷(-5Q)对 q 的静电力: $F_B = k\frac{5Qq}{l^2}$ (引力向右);

试探电荷 q 所受的库仑力为两电荷库仑力的合力, 故 $F_1 = F_B - F_A = k\frac{5Qq}{l^2} - k\frac{Qq}{4l^2} = k\frac{19Qq}{4l^2}$ 。

Electrostatic force exerted by point charge A (+Q) on q: $F_A = k\frac{Qq}{(2l)^2} = k\frac{Qq}{4l^2}$ (repulsive force

to the right);

Electrostatic force exerted by point charge B (-5Q) on q: $F_B = k\frac{5Qq}{l^2}$ (attractive force to the

right);

The electrostatic force on the test charge q is the resultant force of the electrostatic forces

from the two charges, so $F_1 = F_B - F_A = k\frac{5Qq}{l^2} - k\frac{Qq}{4l^2} = k\frac{19Qq}{4l^2}$.

2. 计算 F₂(Calculate F₂):

将两个带异种电荷的小球接触后, 电荷先中和再平分, 总电荷量 $Q_{总} = Q - 5Q = -4Q$,

平分后两小球电荷量均为 $-2Q$;

A 点电荷(-2Q)对 q 的静电力: $F_A' = k\frac{2Qq}{4l^2} = k\frac{Qq}{2l^2}$ (引力向左);

B 点电荷(-2Q)对 q 的静电力: $F_B' = k\frac{2Qq}{l^2}$ (引力向左);

合力 $F_2 = F_A' + F_B' = k\frac{Qq}{2l^2} + k\frac{2Qq}{l^2} = k\frac{5Qq}{2l^2}$ 。

When the two balls with opposite charges are brought into contact, the charges first

neutralize and then are evenly divided. The total charge $Q_{总} = Q - 5Q = -4Q$, and the charge

of each ball is $-2Q$ after division;

Electrostatic force exerted by point charge A (-2Q) on q: $F_A' = k\frac{2Qq}{4l^2} = k\frac{Qq}{2l^2}$ (attractive force

to the left);

Electrostatic force exerted by point charge B (-2Q) on q: $F_B' = k\frac{2Q}{l^2}$ (attractive force to the

left);

Resultant force $F_2 = F_A' + F_B' = k\frac{Qq}{2l^2} + k\frac{2Qq}{l^2} = k\frac{5Q}{2l^2}$.

3. 计算 F₁/F₂(Calculate F₁/F₂):

$\frac{F_1}{F_2} = \frac{k\frac{19Qq}{4l^2}}{k\frac{5Q}{2l^2}} = \frac{19}{10}$ ，故 C 正确，ABD 错误。

$\frac{F_1}{F_2} = \frac{k\frac{19Qq}{4l^2}}{k\frac{5Qq}{2l^2}} = \frac{19}{10}$, so C is correct, and ABD are incorrect.

综上，选 C。(In conclusion, select C.)

第 44 题(Question 44)

题目:一个质量 $m = 0.6,kg$ 的篮球以 $v_1 = 2,m/s$ 的速度水平向左运动，撞击坚硬的墙壁后，以 $v_2 = 1,m/s$ 的速度水平向右反弹，若球与墙壁的接触时间为 0.1 秒，则墙壁对篮球的平均水平作用力大小为(不计空气阻力， $g = 10,m/s^2$)(A basketball with a mass of $m = 0.6,kg$ moves horizontally to the left at a speed of $v_1 = 2,m/s$. When it hits a hard wall, it bounces back horizontally to the right at a speed of $v_2 = 1,m/s$. If the ball is in contact with the wall for 0.1 seconds, the average horizontal force exerted on the basketball by the wall is (Neglect air resistance, $g = 10,m/s^2$))

A. 1.8N(1.8 牛，1.8 newtons)

B. 12N(12 牛，12 newtons)

C. 18N(18 牛，18 newtons)

D. 6N(6 牛，6 newtons)

答案(Answer):C

解析(Explanation):

- 中文解析:

1. 动量定理:合外力的冲量等于动量变化， $F_合 \Delta t = \Delta p = mv_2 - mv_1$ ；

2. 方向规定:取水平向右为正方向， $v_1 = -2,m/s$ ， $v_2 = 1,m/s$ ；

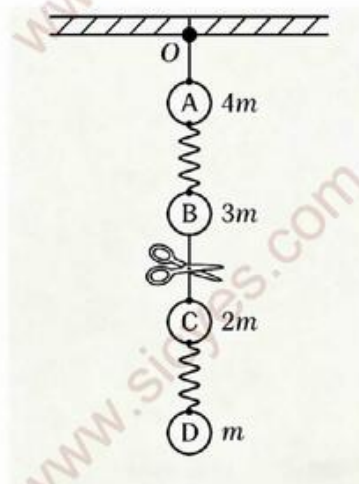3. 计算: $F \times 0.1,s = 0.6,kg \times 1,m/s - 0.6,kg \times (-2,m/s) = 0.6 + 1.2 = 1.8,kg \cdot m/s$ ，解得 $F = 18,N$ 。

- English Explanation:

1. Momentum theorem: The impulse of the resultant force is equal to the change in momentum, $F_{resultant} \Delta t = \Delta p = mv_2 - mv_1$ ；

2. Direction regulation: Take horizontal to the right as the positive direction, $v_1 = -2,m/s$ ， $v_2 = 1,m/s$ ；

3. Calculation: $F \times 0.1,s = 0.6,kg \times 1,m/s - 0.6,kg \times (-2,m/s) = 0.6 + 1.2 = 1.8,kg \cdot m/s$ ，solving for $F = 18,N$.

第 45 题(Question 45)

题目:如图所示，四个质量分别为 4m、3m、2m、m 的小球 A、B、C、D 通过细导线或轻弹簧相互连接，悬挂在 O 点，处于静止状态，重力加速度为 g。若剪断 B、C 之间的细导线，剪断瞬间 B、C 的加速度分别为(As shown in the figure, four small balls A, B, C, and D with masses of 4m, 3m, 2m, and m, respectively, are connected to each other through thin wires or light

springs, suspended at point O, in a stationary state with a gravitational acceleration of g. If the thin wire between B and C is cut, the accelerations of B and C at the instant the wire is cut are, respectively:)

A. 2g, 1.5g

B. g, 1.5g

C. g, 0.5g

D. 2g, 0.5g

答案(Answer):B

解析(Explanation):

- 中文解析:

  1. 剪断前受力平衡:对 C、D 整体，B、C 间导线的拉力 $T = (2m + m)g = 3mg$ ；对 B，上方的拉力 $F = 3mg + 3mg = 6mg$ (B 的重力 3mg + 拉力 T);

  2. 剪断瞬间:弹簧弹力不变，B 的合力 $F_B = F - 3mg = 6mg - 3mg = 3mg$ ，加速度 $a_B = \frac{3mg}{3m} = g$;C 的合力 $F_C = 3mg$ (重力与 D 的拉力),加速度 $a_C = \frac{3mg}{2m} = 1.5g$ 。

- English Explanation:

  1. Force balance before cutting: For the whole of C and D, the tension T of the wire between B and C is $T = (2m + m)g = 3mg$; for B, the upper tension $F = 3mg + 3mg = 6mg$ (gravity of B is 3mg + tension T);

  2. At the instant of cutting: The spring force remains unchanged. The resultant force on B is $F_B = F - 3mg = 6mg - 3mg = 3mg$, and the acceleration $a_B = \frac{3mg}{3m} = g$; the resultant force on C is $F_C = 3mg$ (gravity and tension of D), and the acceleration $a_C = \frac{3mg}{2m} = 1.5g$.

题目:如图所示，水平放置的平行金属导轨两端连接一个电阻 R，导线 ab 可在框架上无摩擦滑动，一个匀强磁场垂直穿过框架平面。当 ab 向右匀速运动时，下列说法正确的是(As shown in the figure, the two ends of parallel metal rails placed horizontally are connected with a resistor R. The wire ab can slide on the frame without friction, and a uniform magnetic field passes vertically through the frame plane. When ab moves uniformly to the right, which of the following statements is correct?)
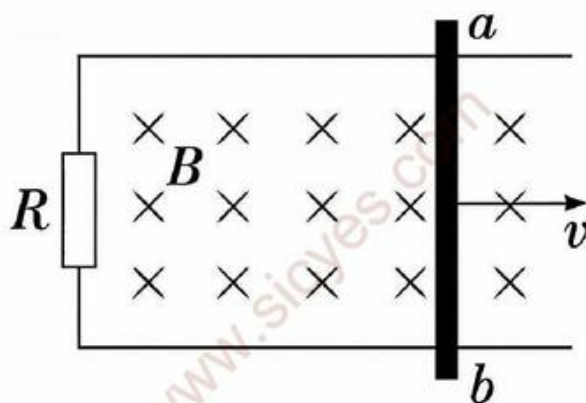
A. 只要导线 ab 达到一定速度，撤去外力，导线 ab 也能在框架上保持匀速运动(As long as the wire ab reaches a certain velocity and the external force is removed, the wire ab can also maintain a uniform motion on the frame)

B. 导线 ab 不仅受到拉力，还受到磁场力(Wire ab is not only subjected to tension force, but also to magnetic field force)

C. 导线 ab 的运动速度恒定，若增大电阻 R 的阻值，拉动导线 ab 的力可以增大(The movement velocity of wire ab is constant. If the resistance value R is increased, the force pulling wire ab can be increased)

D. 导线 ab 的运动速度越高，所需的拉力越小(The higher the velocity of wire ab's movement,

the smaller the required pulling force)

答案(Answer):B

解析(Explanation):

- 中文解析:

1. 电磁感应现象:ab 向右匀速运动切割磁感线，产生感应电流，进而受到安培力(磁场力)，方向向左(阻碍运动);

2. 受力平衡:ab 匀速运动时，水平方向拉力(向右)与安培力(向左)平衡，故 ab 同时受到拉力和磁场力(选项 B 正确);

3. 选项 A 错误:撤去外力后，安培力使 ab 减速;

4. 选项 C 错误:R 增大，感应电流减小，安培力减小，拉力需减小以保持平衡;

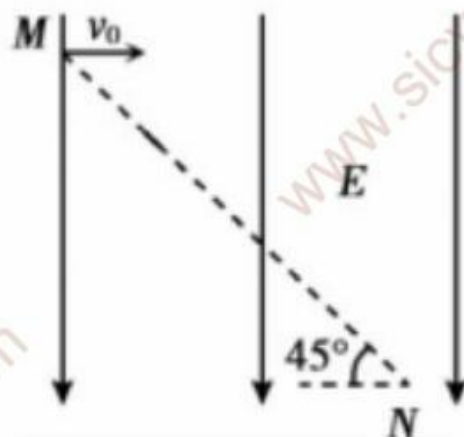5. 选项 D 错误:速度越高，感应电流越大，安培力越大，所需拉力越大。

- English Explanation:

1. Electromagnetic induction phenomenon: The wire ab cuts the magnetic field lines when moving uniformly to the right, generating an induced current, and then experiences an Ampere force (magnetic field force) directed to the left (opposing the motion);

2. Force balance: When ab moves uniformly, the horizontal tension (to the right) balances the Ampere force (to the left), so ab is subjected to both tension and magnetic field force (Option B is correct);

3. Option A is incorrect: After removing the external force, the Ampere force decelerates ab;

4. Option C is incorrect: An increase in R reduces the induced current and Ampere force,

so the tension needs to be reduced to maintain balance;

5. Option D is incorrect: The higher the velocity, the larger the induced current and Ampere force, and the greater the required tension.

第 47 题(Question 47)

题目:如图所示，一个质量为 m、电荷量 $q > 0$ 的粒子，以初速度 v_0 水平射入竖直向下的匀强电场中，电场强度大小为 E。粒子从直线 MN 上的 P 点射出，已知直线 MN 与水平方向成 45°角，不计重力，当粒子回到直线 MN 时(As shown in the figure, a particle of mass m and charge $q > 0$ is projected horizontally into a uniform electric field of magnitude E directed vertically downward. It is projected from point P on the line MN with an initial velocity v_0. Given that line MN makes an angle of 45° with the horizontal, and assuming that gravity is negligible, when the particle returns to the line MN:)

A. 速度与竖直方向的夹角为 30°(The angle that the velocity makes with the vertical direction is 30°)

B. 到 P 点的距离为 $\frac{2\sqrt{2}mv_0^2}{qE}$ (The distance from P is $\frac{2\sqrt{2}mv_0^2}{qE}$)

C. 所用时间为 $\frac{mv_0}{qE}$ (The time it takes is $\frac{mv_0}{qE}$)

D. 速度大小为 $3v_0$ (The velocity is $3v_0$)

答案(Answer):B

解析(Explanation):

- 中文解析:

1. 运动分解:水平方向匀速($x = v_0 t$)，竖直方向匀加速($a = \frac{qE}{m}$ ， $y = \frac{1}{2}at^2$);

2. 回到 MN 的条件:MN 与水平成 45°，故位移偏转角 45°，即 $y = x$ ，得 $\frac{1}{2} \cdot \frac{qE}{m} \cdot t^2 = v_0 t$ ，解得 $t = \frac{2mv_0}{qE}$ (选项 C 错误);

3. 水平位移 $x = v_0 \cdot \frac{2mv_0}{qE} = \frac{2mv_0^2}{qE}$ ，距离 $s = \sqrt{x^2 + y^2} = \sqrt{2}x = \frac{2\sqrt{2}mv_0^2}{qE}$ (选项 B 正确);

4. 竖直速度 $v_y = at = \frac{qE}{m} \cdot \frac{2mv_0}{qE} = 2v_0$ ，合速度 $v = \sqrt{v_0^2 + (2v_0)^2} = \sqrt{5}v_0$ (选项 D 错误);

5. 速度偏转角 $\tan\theta = \frac{v_0}{v_y} = \frac{1}{2}$ ，与竖直方向夹角不是 30°(选项 A 错误)。

- English Explanation:

1. Motion decomposition: Uniform motion in the horizontal direction ($x = v_0 t$), uniformly accelerated motion in the vertical direction ($a = \frac{qE}{m}$, $y = \frac{1}{2}at^2$);

2. Condition for returning to MN: MN makes 45° with the horizontal, so the displacement deflection angle is 45°, i.e., $y = x$. Thus, $\frac{1}{2} \cdot \frac{qE}{m} \cdot t^2 = v_0 t$, solving for $t = \frac{2mv_0}{qE}$ (Option C is incorrect);

3. Horizontal displacement $x = v_0 \cdot \frac{2mv_0}{qE} = \frac{2mv_0^2}{qE}$, distance $s = \sqrt{x^2 + y^2} = \sqrt{2}x = \frac{2\sqrt{2}mv_0^2}{qE}$ (Option B is correct);

4. Vertical velocity $v_y = at = \frac{qE}{m} \cdot \frac{2mv_0}{qE} = 2v_0$, resultant velocity $v = \sqrt{v_0^2 + (2v_0)^2} = \sqrt{5}v_0$ (Option D is incorrect);

5. Velocity deflection angle $\tan\theta = \frac{v_0}{v_y} = \frac{1}{2}$, and the angle with the vertical direction is not 30° (Option A is incorrect).

第 48 题(Question 48)

题目:高速行驶时保持安全车距至关重要。某小型汽车的最大加速度大小为 $6\,\text{m/s}^2$ ，一名司机在高速公路上以 108 千米/时的速度行驶，若司机的反应时间为 1.5 秒，则与前车的最小安全

距离至少为(It is important to maintain a safe driving distance at high speeds. The maximum deceleration of a small car is $6\,m/s^2$. A driver is driving a car on a highway at a speed of 108km/h. If the driver's reaction time is 1.5 seconds, the minimum safe distance from the car ahead should be at least)

A. 90m(90 米，90 meters)

B. 60m(60 米，60 meters)

C. 120m(120 米，120 meters)

D. 150m(150 米，150 meters)

答案(Answer):C

解析(Explanation):

- 中文解析:

  1. 单位统一:将车速换算为国际单位， $108\,km/h = 30\,m/s$ ；

  2. 安全距离组成:最小安全距离 = 反应时间内的匀速行驶距离 + 减速到停止的匀减速行驶距离；

  3. 反应时间内的距离:反应时间内汽车匀速，距离 $s_1 = v \cdot t_{反应} = 30\,m/s \times 1.5\,s = 45\,m$ ；

  4. 减速阶段的距离:由匀减速运动公式 $v^2 = 2as_2$ （末速度 $v = 0$ ），得 $s_2 = \frac{v^2}{2a} = \frac{30^2}{2 \times 6} = 75\,m$ ；

  5. 总安全距离: $s = s_1 + s_2 = 45\,m + 75\,m = 120\,m$ 。

- English Explanation:

  1. Unit unification: Convert the vehicle speed to SI units, $108\,km/h = 30\,m/s$ ；

  2. Composition of safe distance: Minimum safe distance = uniform driving distance
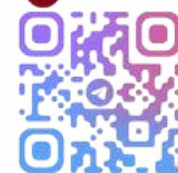
during reaction time + uniform deceleration distance to stop;

3. Distance during reaction time: The car moves uniformly during the reaction time, distance $s_1 = v \cdot t_{\text{reaction}} = 30\,\text{m/s} \times 1.5\,\text{s} = 45\,\text{m}$;

4. Distance during deceleration phase: From the uniform deceleration motion formula $v^2 = 2as_2$ (final velocity $v = 0$), we get $s_2 = \dfrac{v^2}{2a} = \dfrac{30^2}{2 \times 6} = 75\,\text{m}$;

5. Total safe distance: $s = s_1 + s_2 = 45\,\text{m} + 75\,\text{m} = 120\,\text{m}$ 。