



AP PHYSICS C: MECHANICS

# AP物理C力学

「2021 版本」

新样题

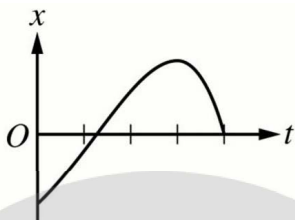
有干货 x 有陪伴 x 有进步

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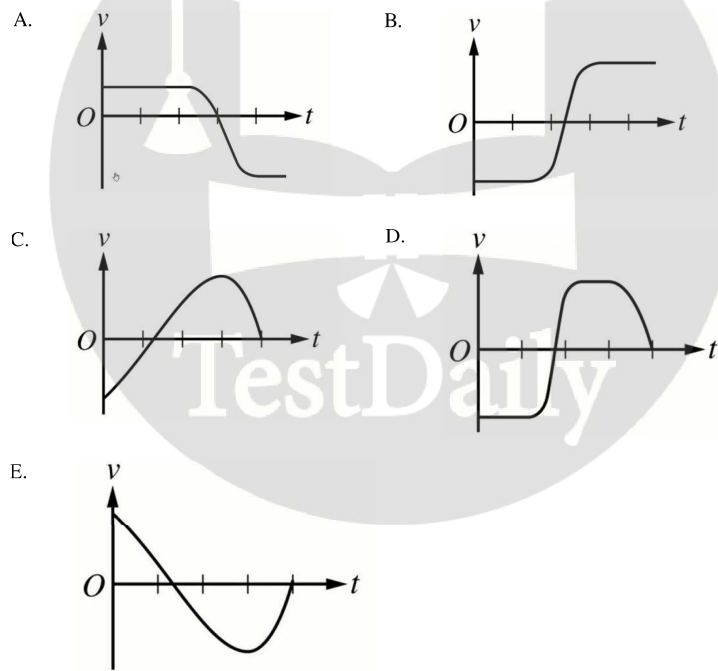
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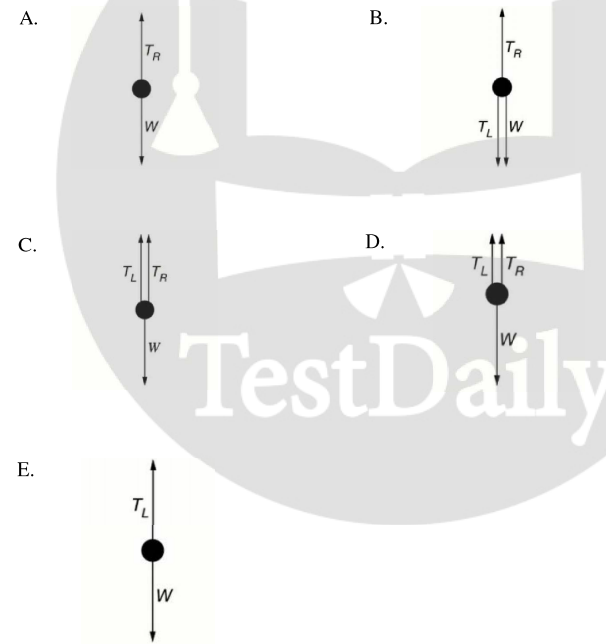
Section I: Multiple-Choice Question-Part 1

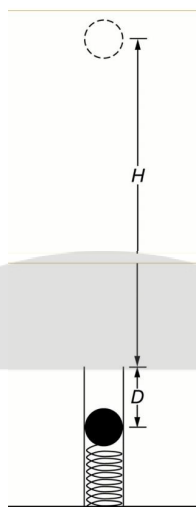


1. The graph shows the position  $x$  as a function of time  $t$  of an object in linear motion. Which of the following graphs best represents the velocity  $v$  of the object as a function of  $t$ ?



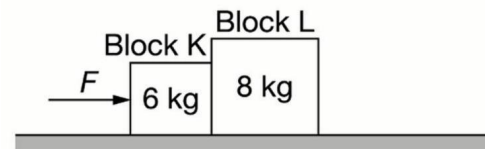
2. The swing shown is attached to a rope that passes over an ideal pulley and then back down to the hands of a child sitting on the swing. The tensions in the rope on the left and one the right are  $T_L$  and  $T_R$ , respectively, and the weight of the child plus the swing is  $W$ . Which of the following free-body diagrams best shows the child and the swing if they are to remain at rest and in equilibrium?





3. An experiment is performed to determine the unknown mass of a sphere. A spring-loaded launcher is used to launch the sphere. The launcher is set to exert a force with an average magnitude of  $F$  on the sphere over a distance  $D$ . The sphere is launched vertically upward and takes a time  $t$  to reach a height  $H$ , as shown in the figure. Which of the following gives the minimum data needed to determine the mass of the sphere?

- A.  $F$  only
- B.  $F$  and  $D$  only
- C.  $F$ ,  $H$ , and  $t$
- D.  $H$ ,  $t$ , and  $D$
- E.  $F$ ,  $D$ , and  $H$



4. Blocks  $K$  and  $L$  are initially at rest on a horizontal surface of negligible friction. A horizontal force  $F$  is exerted on block  $K$ , as shown in the figure, and the blocks move to the right with an acceleration of  $2 \frac{\text{m}}{\text{s}^2}$ . The magnitude of the force exerted on block  $K$  by block  $L$  is

- A. Zero
- B. 2N
- C. 12N
- D. 16N
- E. 28N



5. A particle  $P$  is located on the  $x$ -axis, as shown in the figure. A force exerted on the particle is given by the equation  $F = kx^3$ , where  $k = 4 \frac{\text{N}}{\text{m}^3}$ . How much work is done by the force in moving the particle from  $x = 2 \text{ m}$  to  $x = 1 \text{ m}$ ?

- A. 15J
- B. 28 J
- C. 32 J
- D. 36J
- E. 60 J

## Section II: Multiple-Choice Question-Part 2

1. A motor rated with power  $P$  is used to lift an object of weight  $W$  at constant speed to a height  $H$  in time  $t$ . The work done in lifting the box is  $W$ . A motor rated with power  $2P$  is used to lift the same object to the same height  $H$  in time  $t_2$ . The new work done in lifting the box is  $W_2$ .

Which of the following claims correctly describes the relationships between the two times and two values of work done and is supported with appropriate reasoning?

- A.  $W_2 > W$  and  $t_2 < t$ , because the more powerful motor can do more work and do the work faster.
- B.  $W_2 > W$  and  $t_2 < t$ , because whenever the work is done faster, more work will be done.
- C.  $W_2 = W$  and  $t_2 < t$ , because the object is lifted to the same height and the more powerful motor can do work faster.
- D.  $W_2 > W$  and  $t_2 < t$ , because the object is lifted to the same height and the more powerful motor can do work faster.
- E.  $W_2 = W$  and  $t_2 = t$ , because the object is lifted to the same height, and the work done and the time to do the work will be the same.

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2. The velocity of a projectile at launch has a horizontal component  $v_h$  and a vertical component  $v_v$ . Air resistance is negligible. When the projectile is at the highest point of its trajectory, which of the following show the vertical and horizontal components of its velocity and the vertical component of its acceleration?

A.

| Vertical Velocity | Horizontal Velocity | Vertical Acceleration |
|-------------------|---------------------|-----------------------|
| $v_v$             | $v_h$               | 0                     |

B.

| Vertical Velocity | Horizontal Velocity | Vertical Acceleration |
|-------------------|---------------------|-----------------------|
| $v_v$             | 0                   | 0                     |

C.

| Vertical Velocity | Horizontal Velocity | Vertical Acceleration |
|-------------------|---------------------|-----------------------|
| 0                 | $v_h$               | 0                     |

D.

| Vertical Velocity | Horizontal Velocity | Vertical Acceleration |
|-------------------|---------------------|-----------------------|
| 0                 | 0                   | $g$                   |

E.

| Vertical Velocity | Horizontal Velocity | Vertical Acceleration |
|-------------------|---------------------|-----------------------|
| 0                 | $v_h$               | $g$                   |

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Questions 3 through 4 refer to the following.

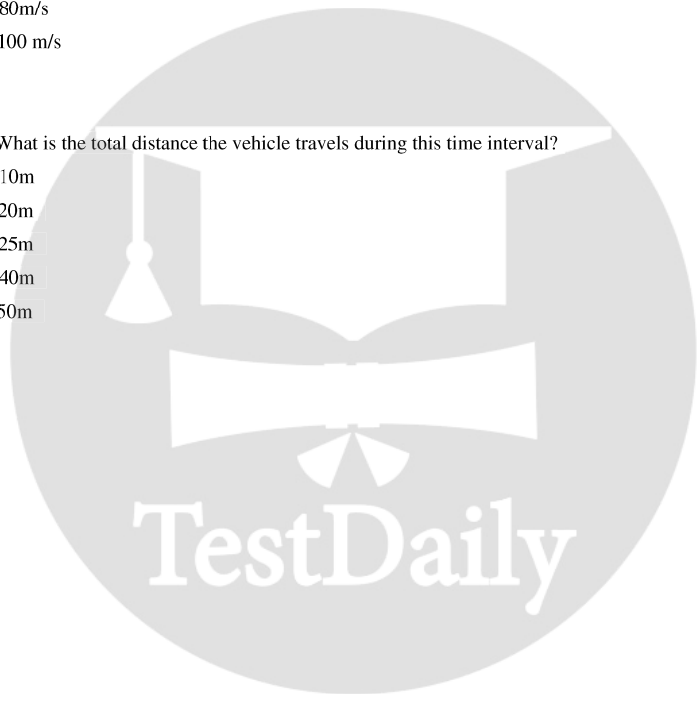
Starting from rest, a vehicle accelerates on a straight level road at the rate of  $4.0 \frac{m}{s^2}$  for 5.0 s.

3. What is the speed of the vehicle at the end of this time interval?

- A. 1.3 m/s
- B. 10 m/s
- C. 20 m/s
- D. 80 m/s
- E. 100 m/s

4. What is the total distance the vehicle travels during this time interval?

- A. 10 m
- B. 20 m
- C. 25 m
- D. 40 m
- E. 50 m



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## 2021 Digital Exam Practice



# AP Physics C: Mechanics

## Scoring Materials for Digital Exam Practice

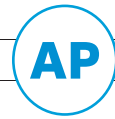
**Please note:** the digital exam practice resource was developed for students to complete technology checks, experience the digital platform, and practice answering exam questions, including each type of multiple-choice question they will encounter on exam day.

This digital exam practice is not a full-length exam, and it does not represent the complete scope of content and skills that students will see on the actual AP exam. This digital exam practice includes only content that would typically be taught in the first half of the school year, following the unit sequence in the AP Physics C: Mechanics Course and Exam Description. For more information on the 2021 Exam format, please visit: [apcentral.collegeboard.org/pdf/ap-2021-exam-formats.pdf](https://apcentral.collegeboard.org/pdf/ap-2021-exam-formats.pdf)

AP Exams are scored differently than traditional high school or college exams. When an AP Exam is administered, psychometric analysis determines the score ranges corresponding with each AP Exam score (5, 4, 3, 2, and 1) based on a composite score scale that combines and weights the different exam parts. Earning 40-50% of the available points can result in a score of 3 or better on many AP Exams. However, because the number of points corresponding with each AP Exam score can vary on different exams, students and teachers should not use the results of the digital exam practice to predict performance on the 2021 AP Exam.

## Multiple-Choice Answer Key

| Multiple-Choice Question | Answer |
|--------------------------|--------|
| 1                        | A      |
| 2                        | D      |
| 3                        | E      |
| 4                        | D      |
| 5                        | A      |
| 6                        | C      |
| 7                        | E      |
| 8                        | C      |
| 9                        | E      |



### Section I: Multiple-Choice Question-Part 1

1. 答案: A

考点: 考察 Unit 1 Kinematics 中从  $x-t$  图象中看速度;

题目: 根据  $x-t$  图象判断  $v-t$  图象;

解析: 在  $x-t$  图象中各点速度  $v$  是曲线的切线斜率, 从图中看出斜率先是一个正的定值 (对应向上的斜直线), 然后逐渐减小到 0 (对应  $x$  的最高点), 再继续减小变为负数, 所以选 A。

2. 答案: D

考点: 考察 Unit 2 Newton's laws of motion 中的受力平衡;

题目: 小孩坐在秋千上, 吊着秋千的绳子穿过滑轮被小孩握在手中, 判断受力分析图;

解析: 对小孩和秋千组成的整体来说, 受到向下的重力, 以及左边和右边的绳子分别向上的拉力, 只有 CD 符合。再根据受力平衡, 应该有  $T_L + T_R = W$ , 所以  $T_L = T_R = \frac{1}{2}W$ , 拉力应该画得比重力得箭头短, 所以选 D。

3. 答案: E

考点: 考察 Unit 3 Work, energy, and power 中的功能关系;

题目: 发射器给小球一个恒力  $F$ 、作用距离  $D$  使小球向上抛出, 经时间  $t$  到达最高点的高度为  $H$ , 要确定小球质量需要的最少数据;

解析: 根据功能关系, 从发射到最高点的过程中, 发射器对小球做的功等于小球增加的机械能, 由于初末状态速度都为 0 所以增加的机械能就是重力势能, 有  $FD = Mg(H + D)$ , 所以需要  $F$ 、 $D$ 、 $H$  就可以求出小球质量, 选 E。

4. 答案: D

考点: 考察 Unit 2 Newton's laws of motion 中的牛顿第二定律和第三定律;

题目: 两个物体  $K$  和  $L$  在外力  $F$  作用下从静止开始一起在无摩擦平面上运动, 已知加速度, 求  $L$  给  $K$  的力;

解析: 根据牛顿第三定律,  $L$  给  $K$  的力大小等于  $K$  给  $L$  的力; 再根据牛顿第二定律,  $K$  给  $L$  的力等与  $L$  的质量乘以加速度, 所以  $F_{LtoK} = F_{KtoL} = M_L a = 8 \text{ kg} \times 2 \text{ m/s}^2 = 16 \text{ N}$ , 选 D。

5 答案: A

考点: 考察 Unit 3 Work, energy, and power 中变力做功的计算;

题目: 已知  $F$  的表达式求物体从  $x=2 \text{ m}$  运动到  $x=1 \text{ m}$  过程中  $F$  做的功;

解析: 根据功的定义, 变力做功是力对位移的积分, 所以  $W = \int_2^1 kx^3 dx = x^4 \Big|_2^1 = -15 \text{ J}$ ,

只考虑大小的话就选 A。

## Section I: Multiple-Choice Question-Part 2

1. 答案: C

考点: 考察 Unit 3 Work, energy, and power 中的功能关系和功率的定义;

题目: 使同一物体匀速上升相同高度但是功率变为 2 倍, 比较做的功和时间;

解析: 使同一物体匀速上升相同高度, 动能不变、增加的重力势能  $MgH$  相同, 所以根据功能关系  $W = \Delta E$  需要的功相同; 功率  $P = W/t$ , 所以功率大所需时间就少, 选 C。

2. 答案: E

考点: 考察 Unit 1 Kinematics 中的抛物运动;

题目: 求抛物运动最高点的竖直速度、水平速度、竖直加速度;

解析: 到达最高点意味着竖直速度减为 0 (否则会继续上升), 而水平方向没有加速度是匀速运动所以在最高点的水平速度就是初始水平速度, 在空中竖直方向有恒定的重力加速度  $g$ , 综上选 E。

3. 答案: C

考点: Unit 1 Kinematics 中的匀变速运动;

题目: 已知匀加速运动的初速度、加速度和时间, 求末速度;

解析: 根据公式  $v = v_0 + at = 0 + 4 \times 5 \text{ m/s} = 20 \text{ m/s}$ , 选 C。

4. 答案: E

考点: Unit 1 Kinematics 中的匀变速运动;

题目: 已知匀加速运动的初速度、加速度和时间, 求路程;

解析: 根据公式  $\Delta s = v_0 t + \frac{1}{2} at^2 = 0 + \frac{1}{2} \times 4 \times 5^2 \text{ m} = 50 \text{ m}$ , 选 E。

TD