



AP Physics B 2000 Student Samples

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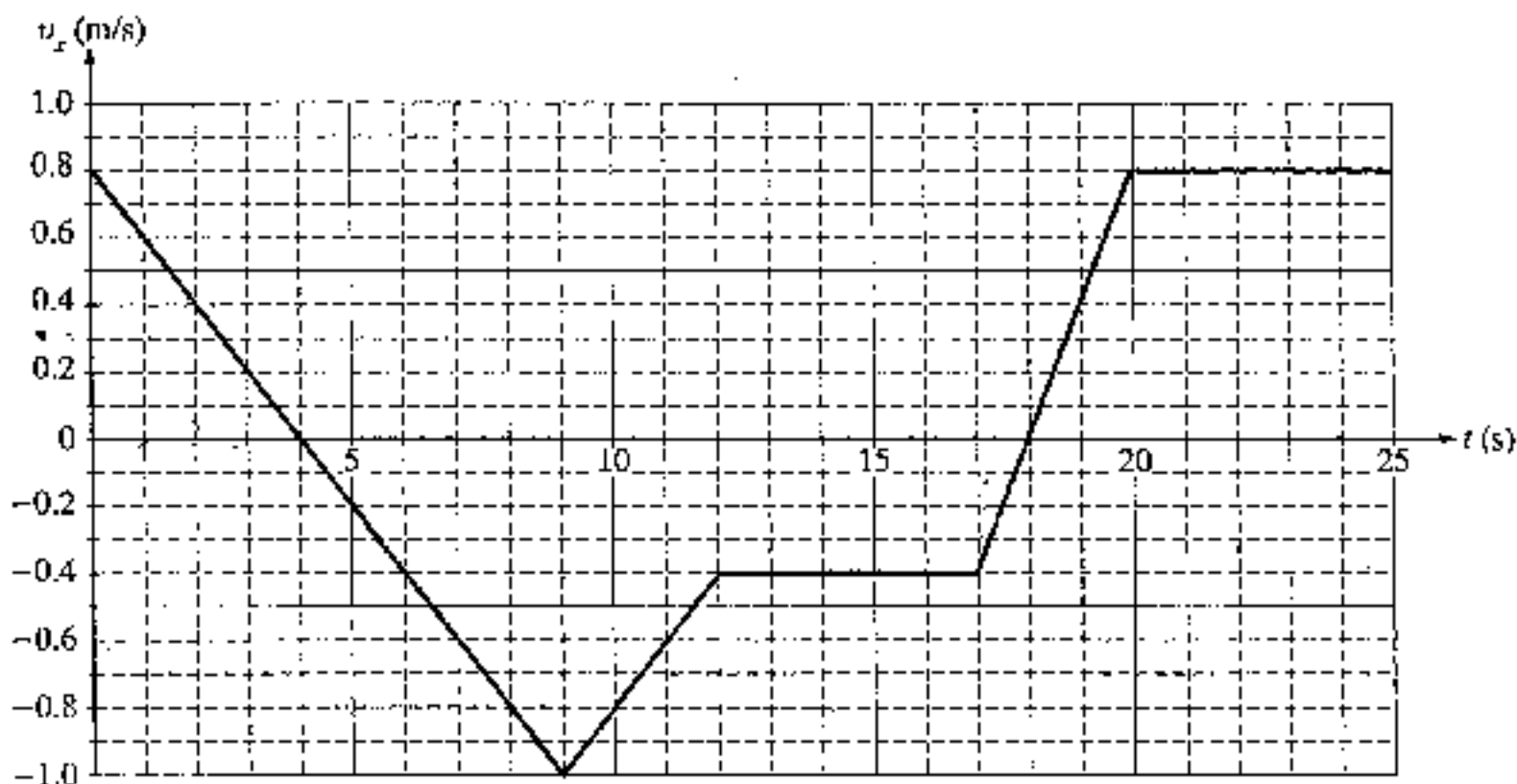
A1

PHYSICS B
SECTION II
Time—90 minutes
7 Questions

Directions: Answer all seven questions, which are weighted according to the points indicated. The suggested time is about 15 minutes for answering each of questions 1-4, and about 10 minutes for answering each of questions 5-7. The parts within a question may not have equal weight. Show all your work in this booklet in the spaces provided after each part, NOT in the green insert.

1. (15 points)

A 0.50 kg cart moves on a straight horizontal track. The graph of velocity v_x versus time t for the cart is given below.



(a) Indicate every time t for which the cart is at rest.

$v_x = 0$ @ $t = 4$ and 18 seconds

(b) Indicate every time interval for which the speed (magnitude of velocity) of the cart is increasing.

speed is increasing from $t = 4$ to 9 seconds and
 18 to 20 seconds

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A2

(c) Determine the horizontal position x of the cart at $t = 9.0$ s if the cart is located at $x = 2.0$ m at $t = 0$.

Uniform acceleration

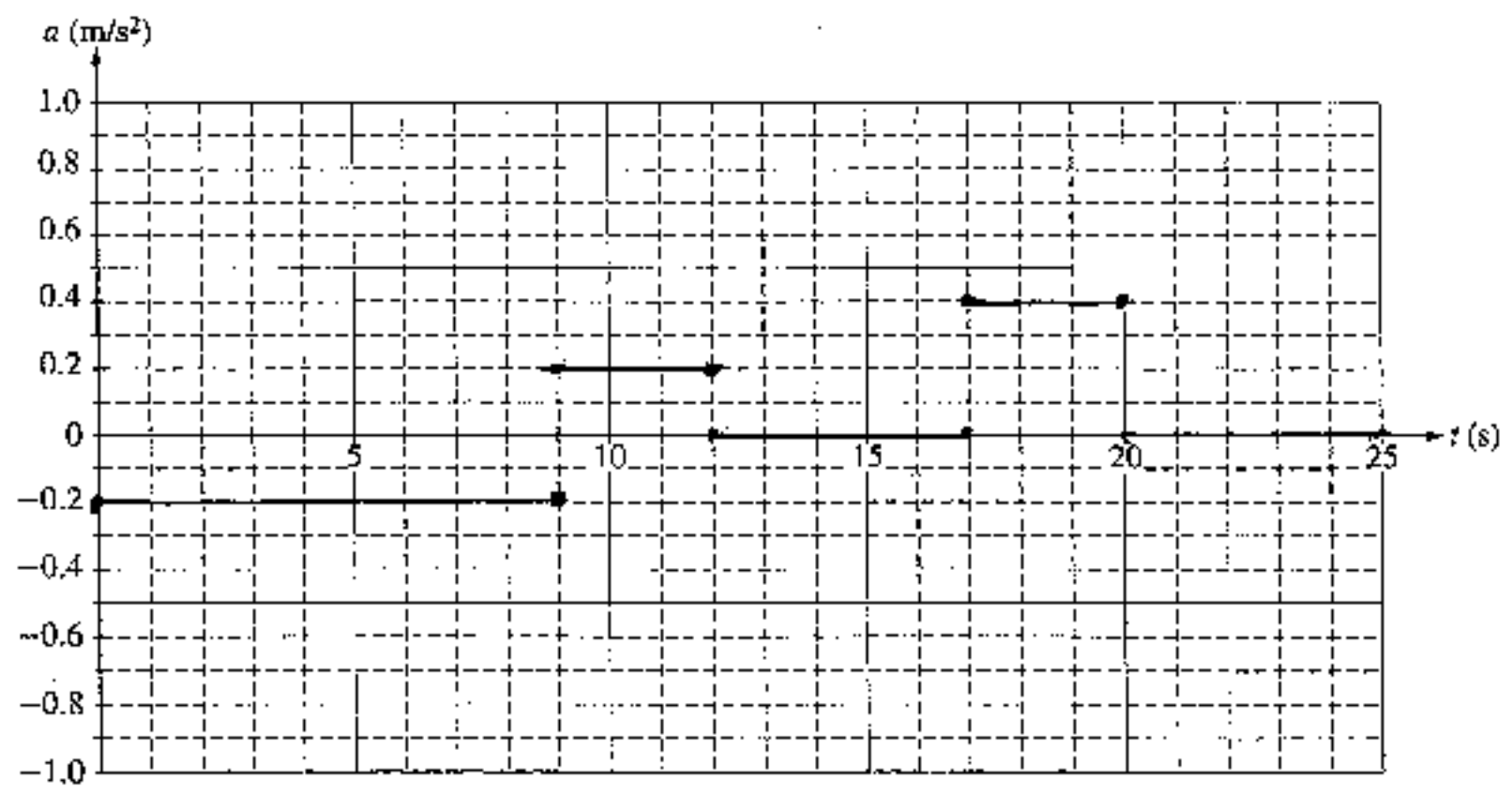
$$s = s_0 + v_0 t + \frac{1}{2} a t^2$$

$$s = 2 + .8(9) + \frac{1}{2}(-.2)(9)^2$$

$$s = 2 + 7.2 - 8.1$$

$$s = 1.1 \text{ m}$$

(d) On the axes below, sketch the acceleration a versus time t graph for the motion of the cart from $t = 0$ to $t = 25$ s.



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- (e) From $t = 25$ s until the cart reaches the end of the track, the cart continues with constant horizontal velocity. The cart leaves the end of the track and hits the floor, which is 0.40 m below the track. Neglecting air resistance, determine each of the following.

i. The time from when the cart leaves the track until it first hits the floor

$$T = \sqrt{\frac{2h}{g}}$$

$$T = \sqrt{\frac{2 \cdot 0.4}{9.8}}$$

$$T = 0.286 \text{ seconds}$$

ii. The horizontal distance from the end of the track to the point at which the cart first hits the floor

$$s = v \cdot T$$

$$s = 0.8 \text{ m/s} \cdot 0.286 \text{ s}$$

$$s = 0.229 \text{ meters}$$

iii. The kinetic energy of the cart immediately before it hits the floor

$$KE = \frac{1}{2} m (v)^2$$

$$\Sigma v = \sqrt{(0.8 \text{ m/s})^2 + (2.8 \text{ m/s})^2}$$

$$\Sigma v = \sqrt{8.44 \text{ m}^2/\text{s}^2}$$

$$v = 2.912 \text{ m/s}$$

$$v = a \cdot t$$

$$0.286 = 9.8 \cdot t$$

$$v_y = 2.8 \text{ m/s}$$

$$KE = \frac{1}{2} (0.5) (2.912)^2$$

$$KE = 2.12 \text{ J}$$

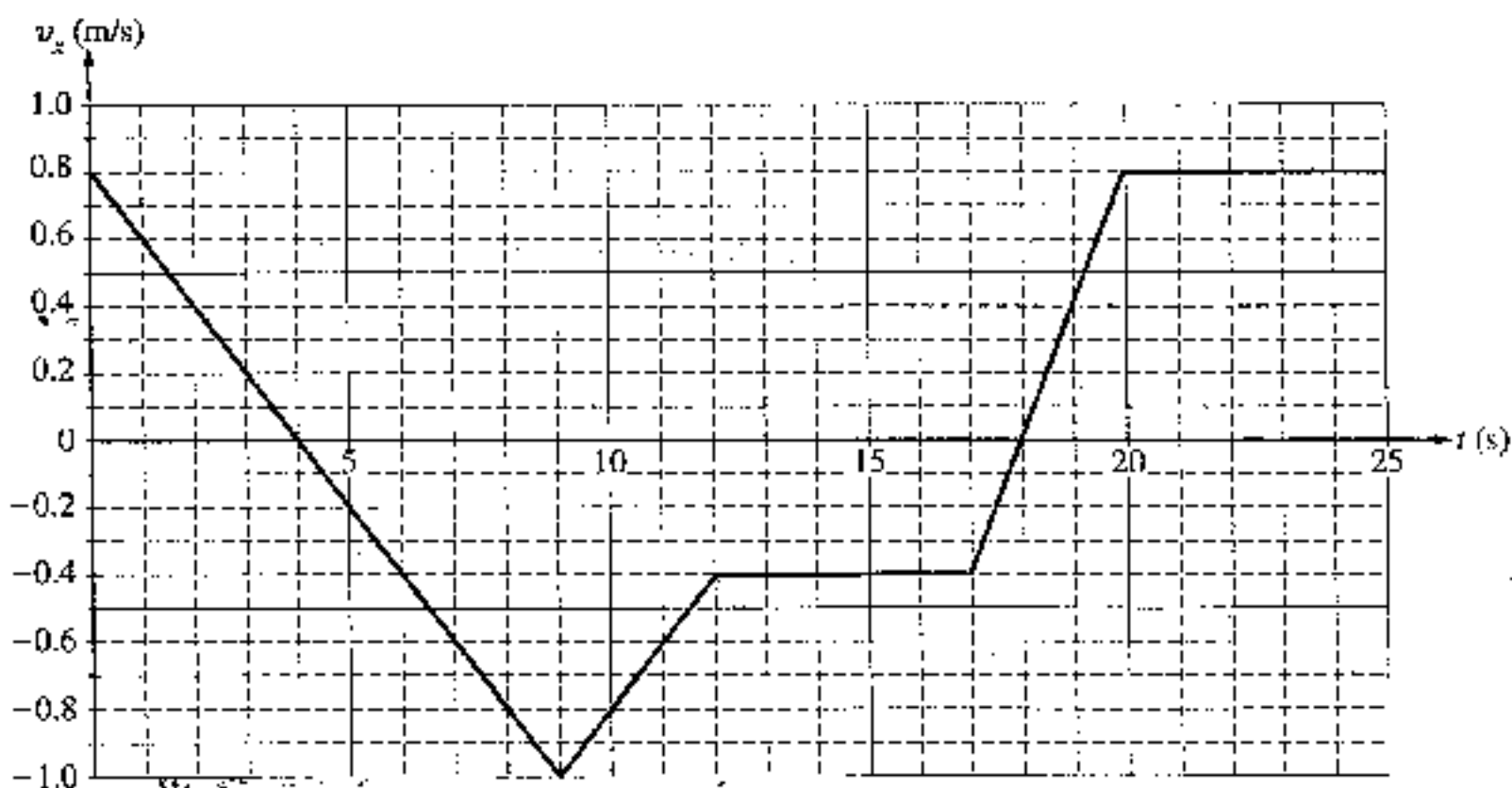
PHYSICS B
SECTION II
Time—90 minutes
7 Questions

B1

Directions: Answer all seven questions, which are weighted according to the points indicated. The suggested time is about 15 minutes for answering each of questions 1-4, and about 10 minutes for answering each of questions 5-7. The parts within a question may not have equal weight. Show all your work in this booklet in the spaces provided after each part, NOT in the green insert.

1. (15 points)

A 0.50 kg cart moves on a straight horizontal track. The graph of velocity v_x versus time t for the cart is given below.



(a) Indicate every time t for which the cart is at rest.

$$t = 4 \text{ s and } t = 18 \text{ s}$$

(b) Indicate every time interval for which the speed (magnitude of velocity) of the cart is increasing.

$$9 \text{ s} < t < 12 \text{ s}$$

$$17 \text{ s} < t < 20 \text{ s}$$

GO ON TO THE NEXT PAGE.

(c) Determine the horizontal position x of the cart at $t = 9.0$ s if the cart is located at $x = 2.0$ m at $t = 0$.

distance traveled between $0.0\text{ s} < t < 4.0\text{ s}$

$$(0.8\text{ m/s}) \times (4.0\text{ s}) \times \frac{1}{2} = 1.6\text{ m}$$

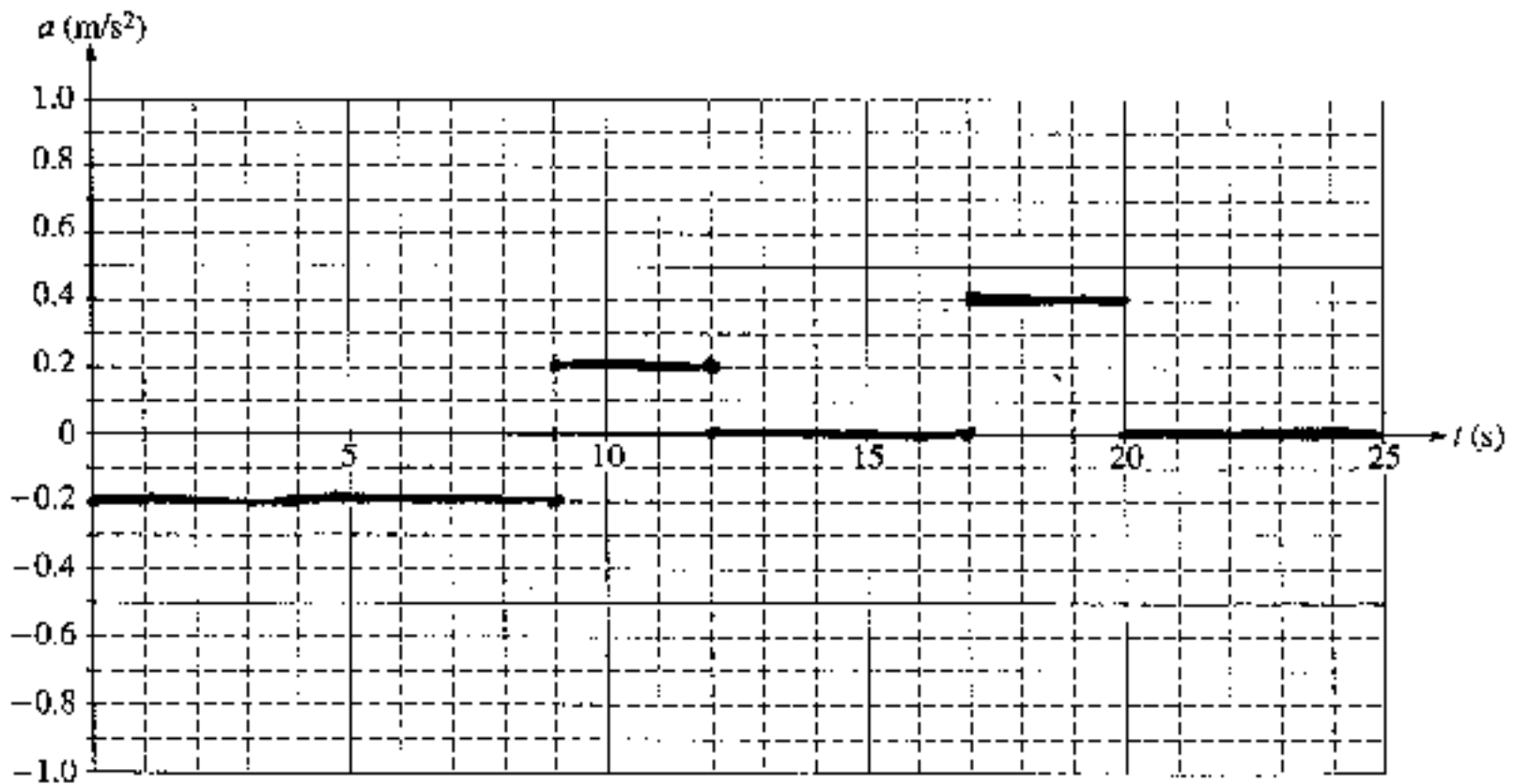
distance traveled between $4.0\text{ s} < t < 9.0\text{ s}$

$$(1.0\text{ m/s}) \times (6.0\text{ s}) \times \frac{1}{2} = -3.0\text{ m}$$

displacement

$$x_0 + x_1 + x_2 = 2.0\text{ m} + 1.6\text{ m} - 3.0\text{ m} = 0.6\text{ m}$$

(d) On the axes below, sketch the acceleration a versus time t graph for the motion of the cart from $t = 0$ to $t = 25$ s.



(c) From $t = 25$ s until the cart reaches the end of the track, the cart continues with constant horizontal velocity. The cart leaves the end of the track and hits the floor, which is 0.40 m below the track. Neglecting air resistance, determine each of the following.

i. The time from when the cart leaves the track until it first hits the floor

$$s = \frac{1}{2}at^2 + v_0 t \quad v_{0y} = 0 \text{ m/s}$$

$$y = \frac{1}{2}gt^2 + v_{0y}t \quad y = 0.40 \text{ m}$$

$$t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2(0.40 \text{ m})}{(9.8 \text{ m/s}^2)}} = 0.29 \text{ s}$$

ii. The horizontal distance from the end of the track to the point at which the cart first hits the floor

$$s = \frac{1}{2}at^2 + v_0 t \quad v_{0x} = 0.8 \text{ m/s}$$

$$x = \frac{1}{2}a_x t^2 + v_{0x} t \quad a_x = 0$$

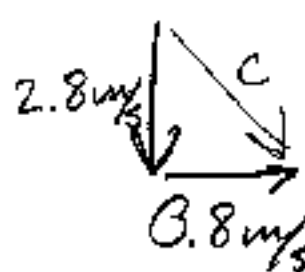
$$x = v_{0x} t$$

$$x = (0.8 \text{ m/s})(0.29 \text{ s}) = 0.23 \text{ m}$$

iii. The kinetic energy of the cart immediately before it hits the floor

$$\vec{v}_f = \vec{v}_0 + a t$$

$$v_{fy} = (0 \text{ m/s}) + (9.8 \text{ m/s}^2)(0.29 \text{ s}) = 2.8 \text{ m/s}$$



$$a^2 + b^2 = c^2 \Rightarrow c = \sqrt{a^2 + b^2}$$

$$c = \sqrt{(0.8 \text{ m/s})^2 + (2.8 \text{ m/s})^2} = 2.9 \text{ m/s}$$

$$v = 2.9 \text{ m/s}$$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(0.50 \text{ kg})(2.9 \text{ m/s})^2 = 2.12 \text{ J}$$

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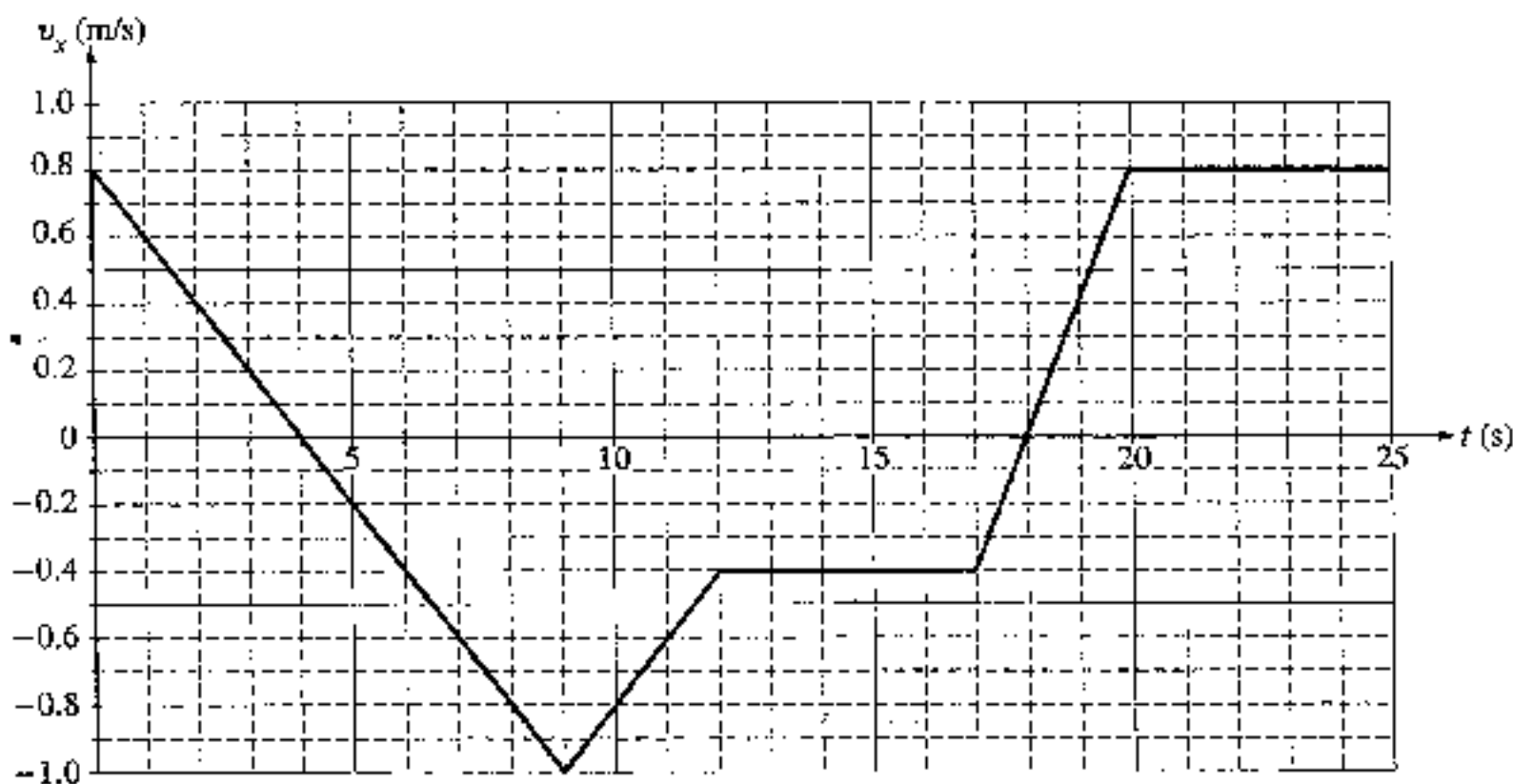
PHYSICS B
SECTION II
Time—90 minutes
7 Questions

C1

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1. (15 points)

A 0.50 kg cart moves on a straight horizontal track. The graph of velocity v_x versus time t for the cart is given below.



(a) Indicate every time t for which the cart is at rest.

Cart at rest at time $t = 4$ and $t = 18$

(b) Indicate every time interval for which the speed (magnitude of velocity) of the cart is increasing.

speed increasing at intervals

$0 < t < 4$, $9 < t < 12$, $17 < t < 18$, $18 < t < 20$

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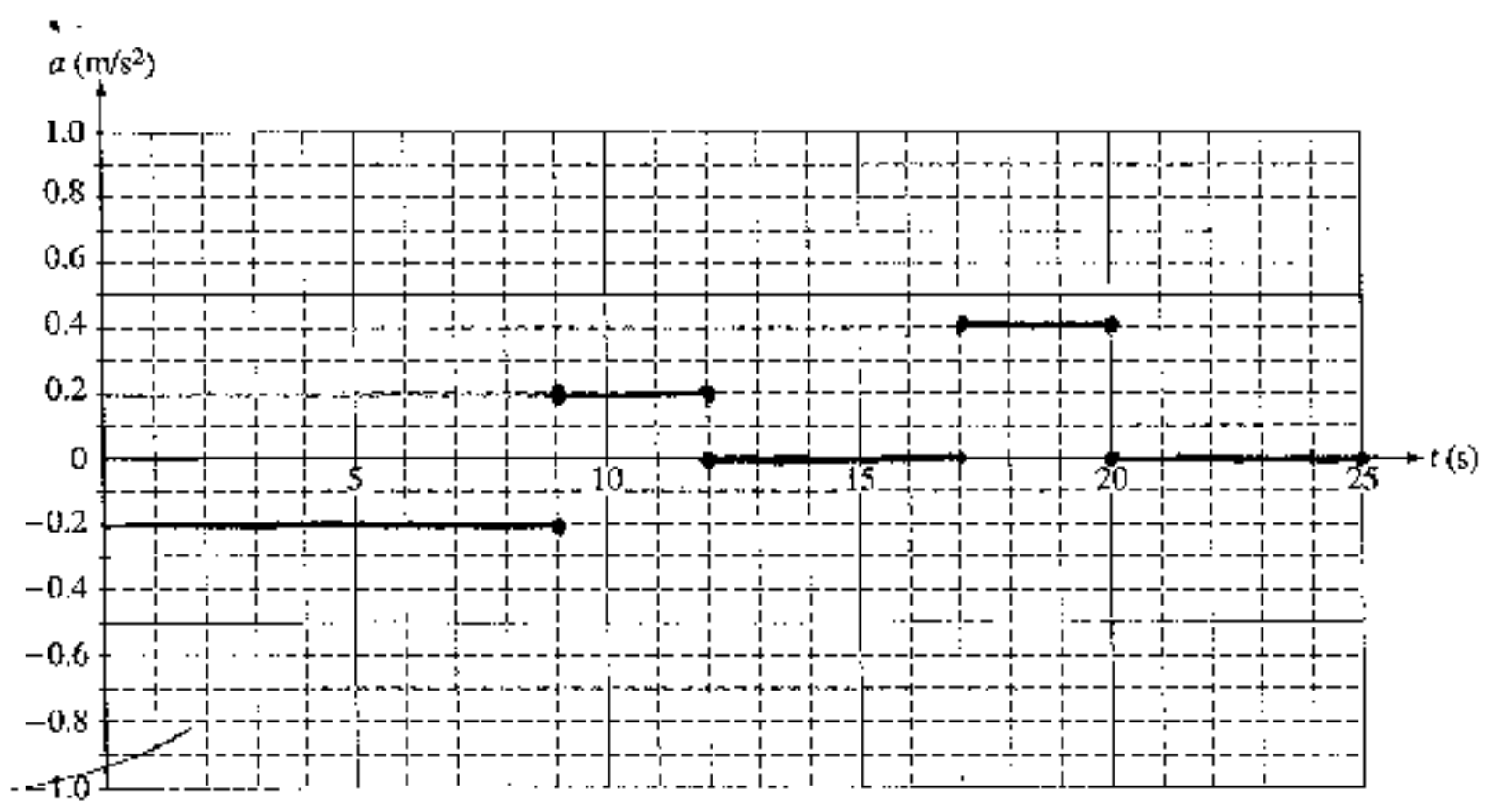
C2

(c) Determine the horizontal position x of the cart at $t = 9.0$ s if the cart is located at $x = 2.0$ m at $t = 0$.

$$-1 + .8 = -.2 \quad 4.5 \times (-.2) = -.9 \quad -.9 + 2 = 1.1$$

1.1 meters

(d) On the axes below, sketch the acceleration a versus time t graph for the motion of the cart from $t = 0$ to $t = 25$ s.



GO ON TO THE NEXT PAGE.

- (e) From $t = 25$ s until the cart reaches the end of the track, the cart continues with constant horizontal velocity. The cart leaves the end of the track and hits the floor, which is 0.40 m below the track. Neglecting air resistance, determine each of the following.

- i. The time from when the cart leaves the track until it first hits the floor

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$.4 = 0 + (0)t + \frac{1}{2} a t^2$$

$$.4 = \frac{1}{2}(9.8)t^2$$

$$.4 = 4.9 t^2$$

$$\frac{.4}{4.9} = t^2$$

$$t = .286 \text{ s}$$

- ii. The horizontal distance from the end of the track to the point at which the cart first hits the floor

$$t = .286 \text{ s} \quad d = vt$$

$$d = (.8 \text{ m/s})(.286 \text{ s}) = .229 \text{ m}$$

- iii. The kinetic energy of the cart immediately before it hits the floor

$$KE = \frac{1}{2} m v^2$$

$$(.5)(.5 \text{ kg})(.8 \text{ m/s})^2 = .16 \text{ J}$$