2026

AP® Physics 2: Algebra-Based

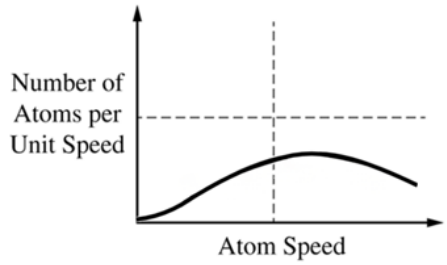
Scoring Guidelines

Question 1: Mathematical Routines (MR) — 10 points

A **(i)** For sketching a concave down curve that has a peak that is to the right of the vertical dashed line — **Point A1**

For sketching a concave down curve that has a peak that is below the horizontal dashed line — **Point A2**

Example Response



Scoring Note: The area bound by the curve and the horizontal axis is not considered when scoring part A (i).

(ii) For a multistep derivation that includes $PV = nRT$, $PV = Nk_BT$, or an equation that is consistent with one of the equations listed — **Point A3**

For indicating **one** of the following correct expressions: — **Point A4**

- The change ΔP in pressure of the gas from State X to State Y (e.g., $\Delta P = 3P - P = 2P$)
- The temperature T_Y of the gas at State Y (e.g., $T_Y = 3\dfrac{PV}{nR}$)

For an appropriate substitution of an expression for ΔP or an expression for T_Y , consistent with point A4, into an expression for ΔT — **Point A5**

(e.g., $\Delta T = \dfrac{(\Delta P)V}{nR} = \dfrac{(3P - P)V}{nR} = \dfrac{2PV}{nR}$ or $\Delta T = T_Y - T_X = 3\dfrac{PV}{nR} - \dfrac{PV}{nR} = 2\dfrac{PV}{nR}$)

Scoring Note: Points A4 and A5 are earned for a correct, isolated, final expression.

Example Responses

Solution 1

$$PV = nRT$$
$$(\Delta P)V = nR\Delta T$$
$$\Delta T = \frac{(\Delta P)V}{nR} = \frac{(3P - P)V}{nR}$$
$$\Delta T = 2\frac{PV}{nR}$$

Solution 2

$$PV = nRT$$
$$T = \frac{PV}{nR}$$
$$T_X = \frac{PV}{nR},\ T_Y = 3\frac{PV}{nR}$$
$$\Delta T = T_Y - T_X = 3\frac{PV}{nR} - \frac{PV}{nR}$$
$$\Delta T = 2\frac{PV}{nR}$$

(iii) For a multistep derivation that includes $Q = mc\Delta T$ — **Point A6**

	For an appropriate substitution of the expression for ΔT, consistent with point A5, into $Q = mc\Delta T$ (e.g., $c = \frac{Q}{m\Delta T} = \frac{Q}{m}\left(\frac{1}{\Delta T}\right) = \frac{Q_S}{m_S}\left(\frac{nR}{2PV}\right)$) **Scoring Note:** Points A5 and A7 are earned for a correct, isolated, final expression even if part A (ii) is blank.	**Point A7**
	Example Response $Q = mc\Delta T$ $c = \frac{Q}{m\Delta T}$ $c_S = \frac{Q_S nR}{m_S(2PV)}$ $c_S = \frac{1}{2}\frac{nRQ_S}{PVm_S}$	
B	For indicating $\lvert\Delta T_S\rvert > \lvert\Delta T_L\rvert$	**Point B1**
	For indicating that the energy transferred from the sphere is the same as the energy transferred to the liquid	**Point B2**
	For indicating the correct functional dependence between mc and ΔT in the equation $Q = mc\Delta T$	**Point B3**
	Example Response *The amount of energy transferred from the sphere is the same as the amount of energy transferred to the liquid. Because both the mass and specific heat of the sphere are less than those of the liquid, the change in temperature of the sphere is greater. Therefore,* $\lvert\Delta T_S\rvert > \lvert\Delta T_L\rvert$.	

Question 2: Translation Between Representations (TBR) — 12 points

A

For drawing at least **two** of the following three arrows that are between unique pairs of discrete states: **Point A1**

- Between $n = 2$ and $n = 3$
- Between $n = 1$ and $n = 2$
- Between $n = 1$ and $n = 3$

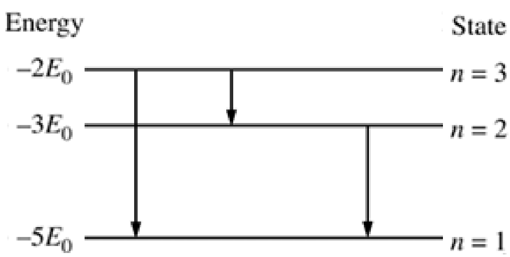
Scoring Note: The directions of the arrows are not considered for earning this point.

For drawing all arrows such that each arrow is directed down **Point A2**

Scoring Note: If a response includes less than or more than three arrows, this point is earned if each arrow is directed down.

For drawing arrows between three unique pairs of discrete states **Point A3**

Example Response



B

For a multistep derivation that includes $E = hf$, $\lambda = \dfrac{c}{f}$, $\lambda = \dfrac{v}{f}$, or an equation that is equivalent to one of the equations listed **Point B1**

For indicating $E = \dfrac{hc}{\lambda}$ or an equivalent equation **Point B2**

Scoring Notes:

- Points B1 and B2 are earned if a multistep derivation begins with $E = \dfrac{hc}{\lambda}$.
- Only point B2 is earned for a response of $E = \dfrac{hc}{\lambda}$ without additional steps of a derivation.

For **one** of the following expressions for the greatest energy E: **Point B3**

- $3E_0$
- An expression that is consistent with the longest arrow that is drawn between two discrete states in Figure 1

Scoring Note: This point can be earned if a negative sign is included with the expression for E.

For an expression for the wavelength λ of the highest-energy photon that can be emitted from the atom that is consistent with the expression for E derived in point B3 (e.g., $\lambda = \dfrac{1}{3}\dfrac{hc}{E_0}$) **Point B4**

Example Response

$$E = hf$$

$$\lambda = \frac{v}{f} = \frac{c}{f}$$

$$f = \frac{c}{\lambda}$$

$$E = \frac{hc}{\lambda}$$

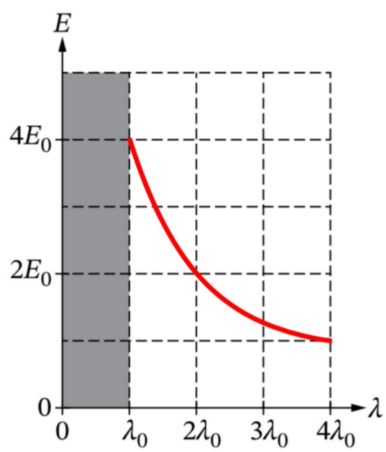
$$\lambda = \frac{hc}{E}$$

$$E = -2E_0 - (-5E_0) = 3E_0$$

$$\lambda = \frac{1}{3}\frac{hc}{E_0}$$

C	For sketching a curve such that the slope is always negative in the region $\lambda_0 < \lambda < 4\lambda_0$	**Point C1**
	For sketching a curve that is always concave up in the region $\lambda_0 < \lambda < 4\lambda_0$	**Point C2**
	For sketching a curve that matches the example response	**Point C3**

Example Response



D	For indicating that the claim is incorrect	**Point D1**
	For a justification that indicates that $4E_0$ is not one of the possible energy differences between two discrete states in the representation from part A	**Point D2**

Example Response

Based on the energy level diagram, no difference between energy states is equal to $4E_0$. *Therefore, the claim is incorrect.*

Question 3: Experimental Design and Analysis (LAB) — 10 points

A (i) For indicating the following **two** quantities: — **Point A1**

- v
- $\mathcal{E}$

(ii) For describing a reasonable method of reducing experimental uncertainty — **Point A2**

Examples of acceptable responses may include the following:

- Multiple measurements of $\mathcal{E}$ and/or v
- Repeat the procedure for different values of $\mathcal{E}$ and/or v
- Repeat the procedure multiple times

Example Response

Measure v and $\mathcal{E}$. Repeat the procedure for different values of v and $\mathcal{E}$.

B (i) For indicating appropriate quantities that can be plotted on a graph to determine B_0 — **Point B1**

Examples of acceptable responses may include the following:

- *$\mathcal{E}$ as a function of v*
- *v as a function of $\mathcal{E}$*
- *$\frac{1}{\mathcal{E}}$ as a function of $\frac{1}{v}$*
- *$\frac{1}{v}$ as a function of $\frac{1}{\mathcal{E}}$*

Scoring Note: This point is earned for a response that correctly identifies the functional dependence between varied quantities, regardless of any coefficients that contain numbers or physical/fundamental constants, or the axis chosen to graph each of those quantities.

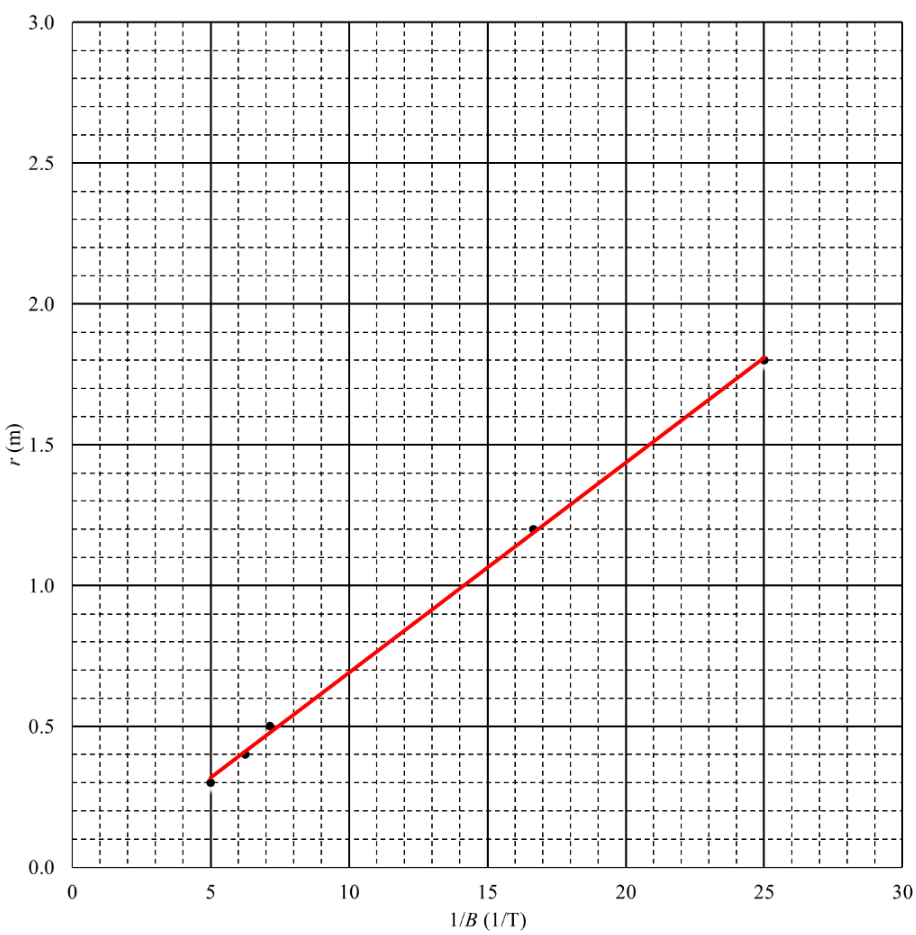
(ii) For indicating how the slope of the graph can be used to determine B_0 — **Point B2**

Examples of acceptable responses may include the following:

- *The slope of $\mathcal{E}$ as a function of v is equal to $B_0 d$.*
- *The slope of v as a function of $\mathcal{E}$ is equal to $\frac{1}{B_0 d}$.*
- *The slope of $\frac{1}{\mathcal{E}}$ as a function of $\frac{1}{v}$ is equal to $\frac{1}{B_0 d}$.*
- *The slope of $\frac{1}{v}$ as a function of $\frac{1}{\mathcal{E}}$ is equal to $B_0 d$.*

C	**(i)**	For labeling **both** axes with appropriate quantities and units that can be plotted to produce a linear graph to determine *m* Examples of acceptable responses may include the following: • *r as a function of* $\frac{1}{B}$ • *B as a function of* $\frac{1}{r}$ • $\frac{1}{B}$ *as a function of r* • $\frac{1}{r}$ *as a function of B* **Scoring Note:** This point is earned for any response that correctly identifies the functional dependence between varied quantities, regardless of any coefficients that contain numbers or physical/fundamental constants, or which axis is chosen to graph each of those quantities.	**Point C1**
	(ii)	For labeling **both** axes with a linear scale	**Point C2**
		For correctly plotting points that are consistent with the quantities labeled in point C1	**Point C3**
	(iii)	For drawing a line or curve that approximates the trend of the plotted data	**Point C4**

Example Response



D	For correctly relating the slope of the straight line of the graph to an appropriate equation that is consistent with an appropriate graph that can be used to calculate m (e.g., $\left(\frac{mv_0}{Q}\right) = \text{slope} = \frac{\Delta r}{\Delta\left(\frac{1}{B}\right)}$)	**Point D1**

Examples of acceptable responses may include the following:

- *The slope of r as a function of* $\frac{1}{B}$ *is equal to* $\frac{mv_0}{Q}$.
- *The slope of* $\frac{1}{B}$ *as a function of r is equal to* $\frac{Q}{mv_0}$.
- *The slope of B as a function of* $\frac{1}{r}$ *is equal to* $\frac{mv_0}{Q}$.
- *The slope of* $\frac{1}{r}$ *as a function of B is equal to* $\frac{Q}{mv_0}$.

For a value for m that is within the range $1.0 \times 10^{-26}\ \text{kg} \le m \le 1.8 \times 10^{-26}\ \text{kg}$ **Point D2**

Scoring Notes:

- A correct, isolated final value earns points D1 and D2 if the slope of the plotted data points is equal to the quantity that is supposed to be determined.
- A correct, isolated final value earns only point D2 if the slope of the plotted data points is not equal to the quantity that is supposed to be determined.

Example Response

$$\text{slope} = \frac{\Delta r}{\Delta\left(\frac{1}{B}\right)} = \frac{(1.4\ \text{m}) - (0.7\ \text{m})}{\left(19.5\ \text{T}^{-1}\right) - \left(10.0\ \text{T}^{-1}\right)}$$

$$\frac{\Delta r}{\Delta\left(\frac{1}{B}\right)} \approx 7.4 \times 10^{-2}\ \text{m} \cdot \text{T}$$

$$\sum F_c = ma_c$$

$$QvB = m\frac{v^2}{r}$$

$$r = \left(\frac{mv_0}{Q}\right)\left(\frac{1}{B}\right), \quad \text{slope} = \frac{mv_0}{Q}$$

$$\frac{\Delta r}{\Delta\left(\frac{1}{B}\right)} = \frac{mv_0}{Q}$$

$$m = \frac{Q(\text{slope})}{v_0}$$

$$m \approx \frac{(6.4 \times 10^{-19}\ \text{C})(7.4 \times 10^{-2}\ \text{m} \cdot \text{T})}{3.0 \times 10^{6}\ \text{m/s}}$$

$$m \approx 1.6 \times 10^{-26}\ \text{kg}$$

Question 4: Qualitative Quantitative Translation (QQT) — 8 points

A	For indicating $v_T < v_S$	**Point A1**
	For indicating **one** of the following: • The electric field is directed in the -*x*-direction. • The change in the electric potential from Point S to Point T is positive. • The change in the electric potential from Point T to Point S is negative. • The sphere moves such that the change in the electric potential energy of the sphere-electric field system is positive. • The electric field does negative work on the sphere.	**Point A2**
	For **one** of the following: • The speed of the sphere decreases because the direction of the electric force exerted on and/or the direction of the acceleration of the sphere is opposite to the direction of motion (i.e., velocity) of the sphere. • The kinetic energy of the sphere decreases because the electric potential energy of the sphere-electric field system increases. • The kinetic energy of the sphere decreases because negative work is done on the sphere. **Scoring Note:** This point is earned if $v_T > v_S$ is indicated, there is an indication that the electric field is directed in the +*x*-direction, and **one** of the following: • The speed of the sphere increases because the direction of the electric force exerted on and/or the direction of the acceleration of the sphere is in the same direction of motion (i.e., velocity) of the sphere. • The kinetic energy of the sphere increases because the electric potential energy of the sphere-electric field system decreases. • The kinetic energy of the sphere increases because positive work is done on the sphere.	**Point A3**
	Example Responses *The electric field is directed from Point T to Point S. Therefore, the force exerted on the sphere is directed in the -x-direction. Because the force is opposite to the velocity of the sphere, the sphere will slow down. Therefore,* $v_T < v_S$. *From Point S to Point T, the electric potential increases. This means that the electric potential energy of the sphere-field system increases. Therefore, the kinetic energy of the sphere decreases. Thus,* $v_T < v_S$. *From Point S to Point T, the electric field does negative work on the sphere. This means that the kinetic energy of the sphere decreases. Thus,* $v_T < v_S$.	

B	For a multistep derivation that either references the conservation of energy/work-energy theorem or includes $\Delta U_E = q\Delta V$, $\Delta V = \frac{\Delta U_E}{q}$, $K = \frac{1}{2}mv^2$, $W = F_{\parallel}d = Fd\cos\theta$, or an equation that is consistent with one of the equations listed	**Point B1**
	For indicating **one** of the following relationships: • $\Delta K = -\Delta U_E$ • $K_S + U_S = K_T + U_T$ **Scoring Note:** The negative sign in $\Delta K = -\Delta U_E$ is not required for earning this point.	**Point B2**
	For a correct expression for K_T (e.g., $K_T = K_S - 5QV_0$)	**Point B3**
	Example Response $\Delta U_E = q\Delta V$ $\Delta U_E + \Delta K = 0$ $\Delta K = -\Delta U_E$ $K_T - K_S = -q\Delta V$ $K_T - K_S = -(+Q)[(2V_0) - (-3V_0)]$ $K_T = K_S - 5QV_0$	
C	For indicating **one** of the following: • $K_{new} > K_T$ • $K_{new} < K_T$ or $K_{new} = K_T$ if the derivation in part B is consistent with the claim of $K_{new} < K_T$ or $K_{new} = K_T$	**Point C1**
	For a justification that addresses how the change in the sign of the charge on the sphere would affect the kinetic energy, consistent with the derivation from part B	**Point C2**

Scoring Notes: The following table summarizes how points are earned in part C if the relationship between K_{new} and K_T is incorrect.

Claim	Is the Derivation Consistent with the Claim?	Is the Justification Consistent with the Derivation?	Point(s) Earned
$K_{new} < K_T$ or $K_{new} = K_T$	Yes	Yes	C1 and C2
$K_{new} < K_T$ or $K_{new} = K_T$	Yes	No	C1
$K_{new} < K_T$ or $K_{new} = K_T$	No	Yes	C2
$K_{new} < K_T$ or $K_{new} = K_T$	No	No	None

- Point C2 is earned if there is no claim, but the justification is consistent with the derivation in part B.
- None of the points are earned if there is no claim, the derivation in part B is blank, and a justification is provided.

Example Response

Because the sign of the charge on the sphere is now negative, $K_{\text{new}} = K_{\text{S}} + 5QV_0$.
Therefore, $K_{\text{new}} > K_{\text{T}}$.