

# FOR TEACHERS ONLY

The University of the State of New York  
REGENTS HIGH SCHOOL EXAMINATION

# PS-P

## PHYSICAL SETTING/PHYSICS

Tuesday, June 18, 2002 — 1:15 to 4:15 p.m., only

### SCORING KEY AND RATING GUIDE

**Directions to the Teacher:**

Refer to the directions on page 3 before rating student papers.

**Part A and Part B-1**

Allow 1 credit for each correct response.

Part A			Part B-1
1 . . . . . <b>4</b> . . . . .	13 . . . . . <b>1</b> . . . . .	25 . . . . . <b>4</b> . . . . .	36 . . . . . <b>2</b> . . . . .
2 . . . . . <b>4</b> . . . . .	14 . . . . . <b>2</b> . . . . .	26 . . . . . <b>4</b> . . . . .	37 . . . . . <b>2</b> . . . . .
3 . . . . . <b>1</b> . . . . .	15 . . . . . <b>4</b> . . . . .	27 . . . . . <b>1</b> . . . . .	38 . . . . . <b>3</b> . . . . .
4 . . . . . <b>3</b> . . . . .	16 . . . . . <b>4</b> . . . . .	28 . . . . . <b>4</b> . . . . .	39 . . . . . <b>1</b> . . . . .
5 . . . . . <b>2</b> . . . . .	17 . . . . . <b>3</b> . . . . .	29 . . . . . <b>1</b> . . . . .	40 . . . . . <b>3</b> . . . . .
6 . . . . . <b>2</b> . . . . .	18 . . . . . <b>3</b> . . . . .	30 . . . . . <b>2</b> . . . . .	41 . . . . . <b>2</b> . . . . .
7 . . . . . <b>2</b> . . . . .	19 . . . . . <b>2</b> . . . . .	31 . . . . . <b>3</b> . . . . .	42 . . . . . <b>4</b> . . . . .
8 . . . . . <b>1</b> . . . . .	20 . . . . . <b>1</b> . . . . .	32 . . . . . <b>4</b> . . . . .	43 . . . . . <b>1</b> . . . . .
9 . . . . . <b>3</b> . . . . .	21 . . . . . <b>1</b> . . . . .	33 . . . . . <b>4</b> . . . . .	44 . . . . . <b>4</b> . . . . .
10 . . . . . <b>2</b> . . . . .	22 . . . . . <b>3</b> . . . . .	34 . . . . . <b>1</b> . . . . .	45 . . . . . <b>1</b> . . . . .
11 . . . . . <b>2</b> . . . . .	23 . . . . . <b>3</b> . . . . .	35 . . . . . <b>1</b> . . . . .	
12 . . . . . <b>1</b> . . . . .	24 . . . . . <b>4</b> . . . . .		



**Directions to the Teacher**

Follow the procedures below for scoring student answer papers for the Physical Setting/Physics examination. Additional information about scoring is provided in the publication *Information Booklet for Administering and Scoring Regents Examinations in the Sciences*.

Use only *red* ink or *red* pencil in rating Regents papers. Do *not* correct the student's work by making insertions or changes of any kind.

On the detachable answer sheet for Part A and Part B–1, indicate by means of a checkmark each incorrect or omitted answer. In the box provided at the end of each part, record the number of questions the student answered correctly for that part.

At least two science teachers must participate in the scoring of each student's responses to the Part B–2 and Part C open-ended questions. Each of these teachers should be responsible for scoring a selected number of the open-ended questions on each answer paper. No one teacher is to score all the open-ended questions on a student's answer paper.

Students' responses must be scored strictly according to the Scoring Key and Rating Guide. For open-ended questions, credit may be allowed for responses other than those given in the rating guide if the response is a scientifically accurate answer to the question and demonstrates adequate knowledge as indicated by the examples in the rating guide. In the student's answer booklet, record the number of credits earned for each answer in the box printed to the right of the answer lines or spaces for that question.

Fractional credit is *not* allowed. Only whole-number credit may be given to a response. Units need not be given when the wording of the questions allows such omissions.

Raters should enter the scores earned for Part A, Part B–1, Part B–2, and Part C on the appropriate lines in the box printed on the answer booklet and then should add these four scores and enter the total in the box labeled "Total Written Test Score." Then, the student's raw scores on the written test should be converted to a scaled score by using the conversion chart printed at the end of this Scoring Key and Rating Guide. The student's scaled score should be entered in the labeled box on the student's answer booklet. The scaled score is the student's final examination score.

All student answer papers that receive a scaled score of 60 through 64 **must** be scored a second time. For the second scoring, a different committee of teachers may score the student's paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student's final examination score is based on a fair, accurate, and reliable scoring of the student's answer paper.

Because scaled scores corresponding to raw scores in the conversion chart may change from one examination to another, it is crucial that for each administration, the conversion chart provided in the scoring key for that administration be used to determine the student's final score. The chart in this scoring key is usable only for this administration of the examination.

Please refer to the Department publication *Regents Examination in Physical Setting/Physics: Rating Guide for Parts B–2 and C*. Teachers should become familiar with this guide before rating students' papers.

### Scoring Criteria for Calculations

For each question requiring the student to show *all calculations, including the equation and substitution with units*, apply the following scoring criteria:

- Allow 1 credit for the equation and substitution of values with units. If the equation and/or substitution with units is not shown, do *not* allow this credit.
- Allow 1 credit for the correct answer (number and unit). If the number is given without the unit, do *not* allow this credit.
- Penalize a student only once per equation for omitting units.
- Allow full credit even if the answer is not expressed with the correct number of significant figures.

### Part B

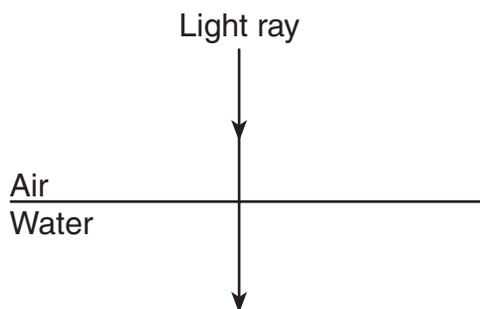
- 46 Allow 1 credit for drawing the correct orientation of the needle of compass Y and labeling its polarity.

#### Example of Acceptable Response



- 47 Allow 1 credit for extending the line straight into the water ( $\pm 2^\circ$ ) as shown below. Do *not* penalize the student if there is no arrowhead.

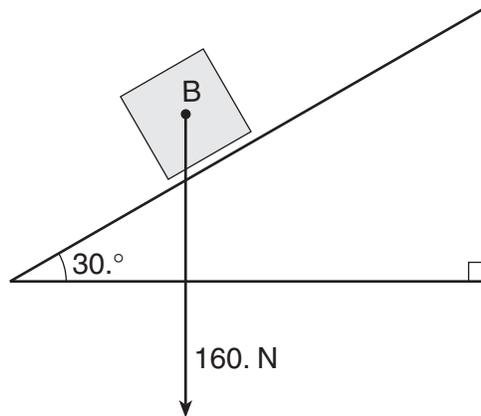
#### Example of Acceptable Response



48 Allow a maximum of 2 credits.

- Allow 1 credit for a line originating at point *B* and having an arrowhead indicating the correct direction with a label.
- Allow 1 credit if the vector, including its arrowhead, is drawn to the proper length (4.0 cm  $\pm$ 0.2 cm).

**Example of Acceptable Response**



49 Allow a maximum of 2 credits for determining the amount of work done. Refer to *Scoring Criteria for Calculations* in this scoring key.

**Examples of Acceptable Responses**

$$F_y = F \sin \theta \text{ and } w = Fd$$

$$F_y = (160. \text{ N})(\sin 30.^\circ) = 80. \text{ N}$$

$$w = (80. \text{ N})(10. \text{ m}) = 800 \text{ J}$$

*or*

$$w = Fd \sin \theta$$

$$w = (160. \text{ N})(10. \text{ m})(\sin 30.^\circ)$$

$$w = 800 \text{ J}$$

*or*

$$w = Fd = \Delta E_T = mgh \text{ and } h = d \sin \theta$$

$$w = mgd \sin \theta$$

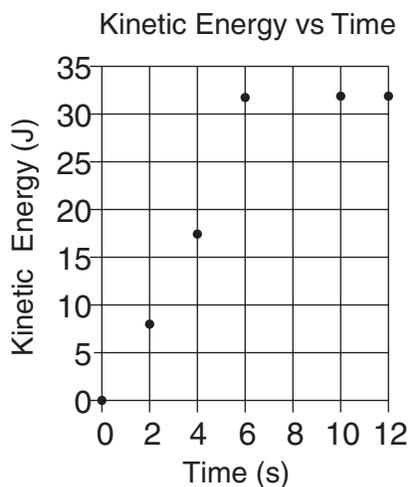
$$w = (160. \text{ N})(10. \text{ m})(\sin 30.^\circ)$$

$$w = 800 \text{ J}$$

50 Allow 1 credit for a scale that is linear and has appropriate divisions.

- 51** Allow 1 credit for plotting all points accurately ( $\pm 0.3$  grid space). Allow credit if the student correctly uses his or her response to question 50. Do *not* penalize the student if no line is drawn.

**50–51 Example of Acceptable Response**



- 52** Allow a maximum of 2 credits for calculating the speed of the mass. Refer to *Scoring Criteria for Calculations* in this scoring key.

**Example of Acceptable Response**

$$KE = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2KE}{m}}$$

$$v = \sqrt{\frac{2(32\text{ J})}{4.0\text{ kg}}}$$

$$v = \sqrt{\frac{16\text{ m}^2}{\text{s}^2}}$$

$$v = 4.0\text{ m/s} \text{ or } v = 4.0\sqrt{\frac{\text{J}}{\text{kg}}}$$

- 53** Allow 1 credit for indicating that the speed of the mass at 6.0 seconds and the speed of the mass at 10.0 seconds are equal.

**Examples of Acceptable Responses**

The speeds are the same.

*or*

The speed of the mass at 6.0 seconds and the speed of the mass at 10.0 seconds are both 4.0 m/s.

Allow credit for an answer that is consistent with the student's response to question 52.

**54** Allow a maximum of 2 credits.

- Allow 1 credit for the substitutions  $\frac{m}{s}$  for  $v$  and  $m$  for  $d$ .
- Allow 1 credit for the answer  $\frac{m}{s^2}$ .

**Example of Acceptable Response**

$$\frac{v^2}{d} = \frac{(m/s)^2}{m} = \frac{m^2/s^2}{m} = \frac{m}{s^2}$$

**Note:** Credit should *not* be allowed for merely giving acceleration units as  $m/s^2$ .

**Examples of Unacceptable Responses:**

$$\frac{v^2}{d} = \frac{m}{s^2}$$

*or*

$$\frac{v^2}{d} = \frac{m/s}{s}$$

**55** Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in the scoring key.

**Examples of Acceptable Responses**

$$v = \frac{d}{t}$$

$$t = \frac{d}{v}$$

$$t = \frac{2\pi r}{v}$$

$$t = \frac{2\pi(2.40m)}{4.00 \text{ m/s}}$$

$$t = 3.77 \text{ s}$$

*or*

$$\bar{v} = \frac{d}{t}$$

$$4.00 \text{ m/s} = \frac{15.08m}{t}$$

$$t = 3.77 \text{ s}$$

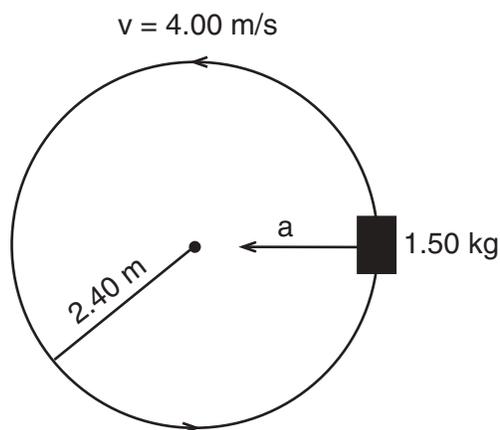
- 56 Allow 1 credit for describing a change that would quadruple the magnitude of the centripetal force.

**Examples of acceptable responses include, but are not limited to:**

- double the speed of the car
- reduce the radius to 0.60 m
- quadruple the mass
- double the mass of the cart and halve the radius
- increase the speed of the cart to 5.66 m/s and double the mass of the cart
- increase the speed of the cart to 5.66 m/s and halve the radius

- 57 Allow 1 credit for drawing and labeling an arrow that represents the direction of the acceleration of the cart.

**Example of Acceptable Response**



**Note:** The label must be included to receive credit.

- 58 Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

**Example of Acceptable Response**

$$E = mc^2$$

$$E = 2(9.11 \times 10^{-31} \text{ kg}) (3.00 \times 10^8 \text{ m/s})^2$$

$$E = 1.64 \times 10^{-13} \text{ J}$$

- 59 Allow 1 credit for **conservation of charge**.

**Part C**

- 60** Allow 1 credit for determining the minimum energy necessary for an electron to change from the *B* energy level to the *F* energy level.

**Examples of Acceptable Responses**

$$19.34 \times 10^{-19} \text{ J}$$

*or*

$$1.934 \times 10^{-18} \text{ J}$$

Allow this credit if the answer above is negative.

- 61** Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

**Examples of Acceptable Responses**

$$E = hf$$

$$f = \frac{E}{h}$$

$$f = \frac{19.34 \times 10^{-19} \text{ J}}{6.63 \times 10^{-34} \text{ J}\cdot\text{s}}$$

$$f = 2.92 \times 10^{15} \text{ Hz}$$

*or*

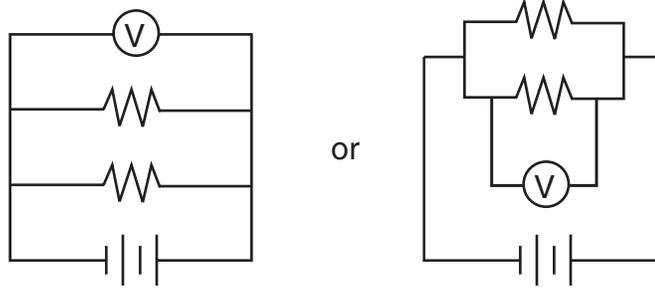
$$f = 2.92 \times 10^{15} \text{ 1/s}$$

Allow credit for an answer that is consistent with the student's response to question 60.

**62** Allow a maximum of 2 credits.

- Allow 1 credit for a circuit containing two resistors connected in parallel with a battery.
- Allow 1 credit for a voltmeter connected in parallel with either resistor, or the battery. If the student has drawn a series circuit and the voltmeter is properly placed to measure the potential difference across either resistor, allow this credit.

**Examples of Acceptable Responses**



**63** Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

**Examples of Acceptable Responses**

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{eq}} = \frac{1}{3.0\Omega} + \frac{1}{3.0\Omega}$$

$$\frac{1}{R_{eq}} = \frac{2}{3.0\Omega}$$

$$R_{eq} = 1.5\Omega$$

*or*

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_{eq} = \frac{(3.0\Omega)(3.0\Omega)}{3.0\Omega + 3.0\Omega}$$

$$R_{eq} = 1.5\Omega$$

Allow credit if the student correctly uses his or her responses to question 62. That is, if the student connected the resistors in series in question 62, then the following answer is acceptable.

$$R_{eq} = R_1 + R_2$$

$$R_{eq} = 3.0\Omega + 3.0\Omega$$

$$R_{eq} = 6.0\Omega$$

**64** Allow a maximum of 4 credits for explaining how to find the coefficient of kinetic friction between a wooden block of unknown mass and a table top in the laboratory. The response must include:

- Measurements needed: normal force (weight or mass) of block, friction force [1]
- Equipment needed: spring scale (and balance if mass of block is used) or computer force sensor [1]
- Procedure: The procedure must include a means of finding the normal force and the force of friction, *and* a means of using them to determine the coefficient of friction, e.g., using the equation *or* finding the slope of a graph. [1]
- Equation:  $F_f = \mu F_N$  (and  $F_g = mg$  if mass is found first) [1]

**Examples of acceptable responses include, but are not limited to:**

To determine the coefficient of friction between a block and the table, I would need to measure the normal force or weight of the block, and the force of friction. The equipment needed is a spring scale. First I would hang the block on the scale to find its weight. Then I would pull the block smoothly (or at constant speed) across the table with the spring scale to find the force of friction. Once I measured the weight and friction forces, I would use the formula  $F_f = \mu F_N$  to calculate the coefficient of friction.

*or*

Use another device for measuring force (e.g., a computer force sensor).

Use a balance to find the mass of the block, then  $g = \frac{F_g}{m}$  to find the weight. Then proceed as above.

*or*

Load various weights onto the block, find the friction for each weight, plot a graph of friction *vs* weight, and find the slope of the graph.

- 65** Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in the scoring key.

**Examples of Acceptable Responses**

$$P = \frac{V^2}{R}$$

$$R = \frac{V^2}{P}$$

$$R = \frac{(120.V)^2}{1050 W}$$

$$R = 13.7\Omega$$

*or*

$$P = VI$$

$$I = \frac{P}{V}$$

$$I = \frac{1050 W}{120 V}$$

$$I = 8.75 A$$

$$R = \frac{V}{I}$$

$$I = \frac{120 V}{8.75 A}$$

$$R = 13.7\Omega$$

- 66** Allow a maximum of 2 credits.
- Allow 1 credit for correctly indicating the total current.
  - Allow 1 credit for stating whether it is possible to operate the toaster and the microwave simultaneously. If the current indicated is greater than 15 A, the answer should be no. If the current indicated is less than 15 A, the answer should be yes.

**Example of Acceptable Response**

$$I = \frac{P}{V} = \frac{1050 W}{120 V} = 8.75 A$$

$$I_{\text{total}} = 8.75 A + 10.0 A = 18.8 A$$

Answer: No

Do *not* penalize student for incorrect or missing units.

**Note:** Allow no credit for a yes or no answer with no mathematical justification.

- 67 Allow a maximum of 2 credits. Refer to *Scoring Criteria for Calculations* in this scoring key.

**Examples of Acceptable Responses**

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\sin \theta_2 = \frac{n_1 \sin \theta_1}{n_2}$$

$$\sin \theta_2 = \frac{1.00 \sin 33^\circ}{1.50}$$

$$\sin \theta_2 = \frac{1.00(0.5446)}{1.50}$$

$$\sin \theta_2 = 0.363$$

$$\theta_2 = 21^\circ$$

or

$$n_1 \sin i = n_2 \sin r$$

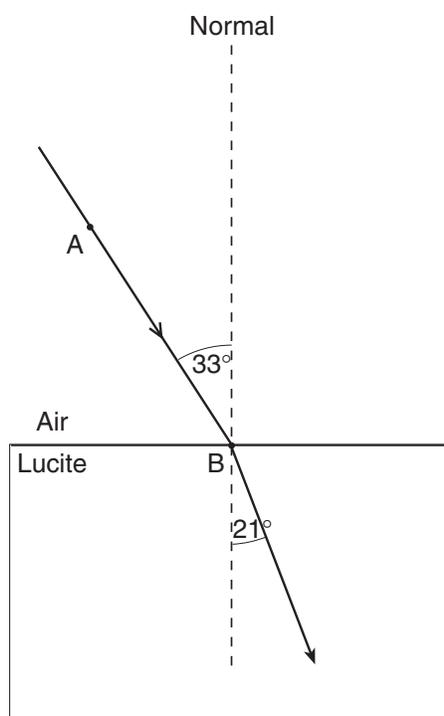
$$(1.00)(\sin 33^\circ) = (1.50) \sin r$$

$$r = 21^\circ$$

- 68 Allow a maximum of 2 credits.

- Allow 1 credit if the angle between the normal and the ray is equal to the angle the student calculated in question 67 ( $\pm 2^\circ$ ).
- Allow 1 credit for an arrow originating at point B, drawn to the right of the normal in Lucite, and directed away from point B.

**Example of Acceptable Response**



- 69** Allow 1 credit for indicating that yellow light travels faster in air than in Lucite.

**Examples of acceptable responses include, but are not limited to:**

Light travels faster in air than in Lucite.

*or*

Yellow light travels slower in Lucite than in air.

Allow credit if the student calculates and identifies the numerical values.

**Regents Examination in Physical Setting/Physics  
June 2002  
Chart for Converting Total Raw Scores to  
Final Examination Scores (Scaled Scores)**

<b>Raw Score</b>	<b>Scaled Score</b>						
85	100	63	70	41	49	19	27
84	98	62	69	40	48	18	26
83	97	61	68	39	47	17	25
82	95	60	67	38	47	16	24
81	93	59	66	37	46	15	23
80	92	58	65	36	45	14	21
79	90	57	64	35	44	13	20
78	89	56	63	34	43	12	19
77	87	55	62	33	42	11	17
76	86	54	61	32	41	10	16
75	85	53	60	31	40	9	14
74	83	52	59	30	39	8	13
73	82	51	58	29	38	7	11
72	81	50	57	28	37	6	10
71	79	49	56	27	36	5	8
70	78	48	56	26	35	4	7
69	77	47	55	25	34	3	5
68	76	46	54	24	33	2	3
67	75	45	53	23	32	1	2
66	73	44	52	22	31	0	0
65	72	43	51	21	30		
64	71	42	50	20	29		

To determine the student's final examination score, find the student's total test raw score in the column labeled "Raw Score" and then locate the scaled score that corresponds to that raw score. The scaled score is the student's final examination score. Enter this score in the space labeled "Final Score" on the student's answer sheet.

All student answer papers that receive a scaled score of 60 through 64 must be scored a second time. For the second scoring, a different committee of teachers may score the student's paper or the original committee may score the paper, except that no teacher may score the same open-ended questions that he/she scored in the first rating of the paper. The school principal is responsible for assuring that the student's final examination score is based on a fair, accurate, and reliable scoring of the student's answer paper.

Because scaled scores corresponding to raw scores in the conversion chart may change from one examination to another, it is crucial that for each administration, the conversion chart provided in the scoring key for the administration be used to determine the student's final score. The chart above is usable only for this administration of the physical setting/physics examination.

## Map to Core Curriculum

<b>June 2002 Physical Setting/ Physics</b>			
<b>Question Numbers</b>			
Key Ideas	Part A	Part B	Part C
<b>Standard 1</b>			
Math Key Idea 1	3-7, 9-11, 14-17, 19, 20, 22, 24, 32-34	41, 44, 49-52 54 - 56, 58	61,63 - 65, 67, 69
Math Key Idea 2		41- 43, 53	
Math Key Idea 3		36	
Sci. Inq Key Idea 1			62
Sci. Inq Key Idea 2			
Sci. Inq Key Idea 3			
Eng. Des. Key Idea 1			
<b>Standard 2</b>			
Key Idea 1			
Key Idea 2			
<b>Standard 6</b>			
Key Idea 1			
Key Idea 2			66
Key Idea 3		39	
Key Idea 4			
Key Idea 5		56	
Key Idea 6			
<b>Standard 7</b>			
Key Idea 1			66
Key Idea 2			
<b>Standard 4 Process Skills</b>			
4.1		38, 42, 46, 49 - 52	62
4.3		37, 45, 47	68
5.1		44, 48, 57	64
5.3		40, 41	60
<b>Standard 4</b>			
4.1	14 -17,21-24, 32, 33, 34	38, 41- 44, 49 - 53	62,63, 65, 66
4.3	19,20,26-29,35	37, 45, 47, 48	67 - 69
5.1	1-13,25	36, 46, 54-57	64
5.3	18,30,31	40, 58, 59	60, 61