CONCEPTS COVERED IN THE EXAMINATION

General Concepts	*Statements Indicating Degree of Complexity*
Kinematics	• Uniform rectilinear motion ➢ Relationship among positions with respect to the point of origin, velocity, and time ➢ Distance and displacement • Uniformly accelerated rectilinear motion ➢ Relationship among acceleration, change in velocity and time (velocity versus time graph) ➢ Relationship among acceleration, distance and time ➢ Average velocity and instantaneous velocity ➢ Free fall ➢ Motion of a body on an inclined plane • Motion of Projectiles
Transformation of Energy	• Mechanical energy • Hooke's Law
Dynamics	• Free body diagram • Equilibrium and resultant of several forces ➢ Determines the magnitude and directionof the vector associated with the resultant force of a system of forces ➢ Determines the magnitude and direction of the vector associated with the balancing force of a system of forces • Gravitational acceleration • Newton's Laws ➢ Applies the mathematical relationship between the force acting on a body, mass and acceleration • Force of friction ➢ Determines the value of the force of friction in a given situation • Centripetal force
Geometric Optics	• Snell's Law, Reflection ➢ Angle of incidence and reflection - Measures the angles of incidence and angles of reflection in a diagram or experiment - Explains qualitatively and quantitatively a phenomenon using the Law of Reflection • Snell's Law, Refraction ➢ Index of refraction - Defines index of refraction of a medium as the ratio of the speed of light in a vacuum - Explains qualitatively and quantitatively a phenomenon using the Law of Refraction - Explains the phenomenon of total internal reflection • Images ➢ Image Characteristics - Determine the characteristics of the image formed in a given situation - Applies the mathematical relationship to determine the position, orientation and height of an object or its image in the case of mirrors or lenses
Measurement Techniques	• Interpreting measurement results (significant figures)

WEIGHTING TABLE

Content / Question	Geometric Optics	Kinematics	Dynamics	Transformation of Energy	Measurement Techniques
Weighting					
Section A	30%	30%	30%	10%	---
Section B	30%	30%	22%	15%	3%

SCORING OF THE EXAMINATION

Marking Guide

GUIDELINES FOR CORRECTING QUESTIONS

The marking scale for correcting the answers to the questions of the examination is presented below, along with explanations of the terms used in the scale.

It is IMPORTANT that the teacher read this information carefully before correcting the examination.

Questions usually consist of two parts: the procedure used to solve the problem and the answer. Thus, a question should be corrected in two steps.

Step 1

Analyze the work to understand the procedure used by the student, and then decide if the procedure is appropriate or not.

A procedure is appropriate if the steps presented could lead to the correct answer.

A procedure is partially appropriate if the steps presented do not lead to the correct answer, but include at least one step that is relevant and correct.

A procedure is inappropriate if none of the steps presented are relevant or if the student has not shown any work.

Step 2

If the procedure is deemed appropriate, then evaluate the answer. If the answer is incorrect, identify the type of error made.

The error is considered minor if it is an error in calculation or transcription, if the unit of measurement is incorrect or missing, or if the student has rounded off a number incorrectly.

The error is considered major if a law, rule, or formula has been applied incorrectly.

No marks are allotted for a correct answer when the procedure used is inappropriate.

The application of significant figures should be considered during the correction of this examination.
Do not mark each question for significant figures. Three marks will be allocated for the appropriate use of significant figures for Questions 11, 16 and 19.

MARKING GUIDE

Part A
Multiple Choice Questions

Questions 1 to 10

Question 1 B

Question 2 D

Question 3 A

Question 4 B

Question 5 B

Question 6 A

Question 7 C

Question 8 C

Question 9 D

Question 10 C

Part B
Extended Constructed Response Questions

Questions 11 to 21

Question 11

Example of an appropriate procedure

$n = 1.51$
$\Delta d = 1.5 \text{ cm} = 0.015 \text{ m}$
$c = 3.00 \times 10^8 \text{ m/s}$

Speed of light in Plexiglas®

$$n = \frac{c}{v}$$

$$v = \frac{c}{n} = \frac{3.00 \times 10^8 \text{ m/s}}{1.51}$$
$$= 1.987 \times 10^8 \text{ m/s}$$

Time to travel through Plexiglas®
$\Delta d = 0.015 \text{ m}$
$v = 1.987 \times 10^8 \text{ m/s}$

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

$$\Delta t = \frac{\Delta d}{v} = \frac{0.015 \text{ m}}{1.987 \times 10^8 \text{ m/s}} = 7.55 \times 10^{-11} \text{ s}$$

Answer

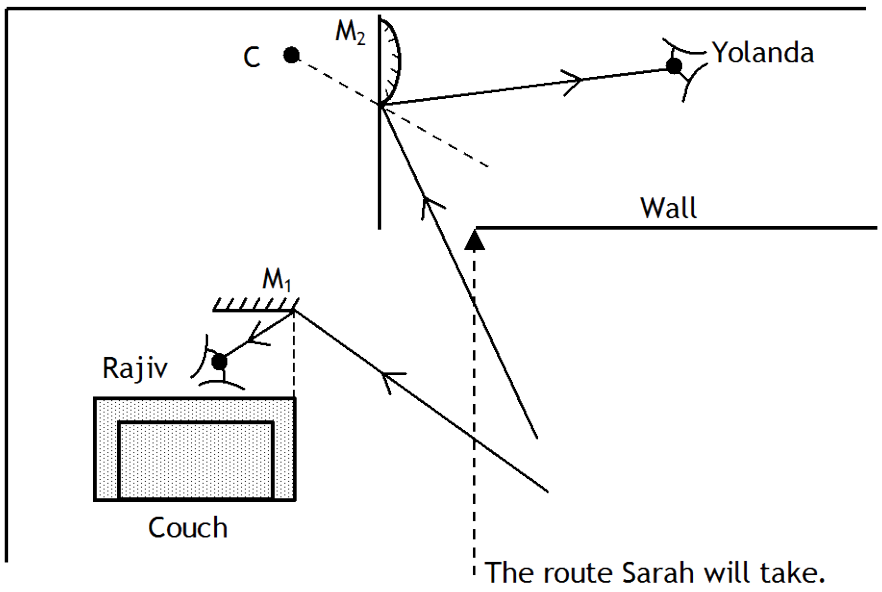
The time that it would take light to pass from one side of the Plexiglas® to the other is **7.6×10^{-11} s**.

Marking Scale	
4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate procedure with a major error (e.g. inappropriate use of a law or formula).
1 mark	Partially appropriate procedure (e.g. determines the speed of light in Plexiglas®).
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

**** Significant figures will be evaluated.***

Question 12

Example of an appropriate procedure



Answer

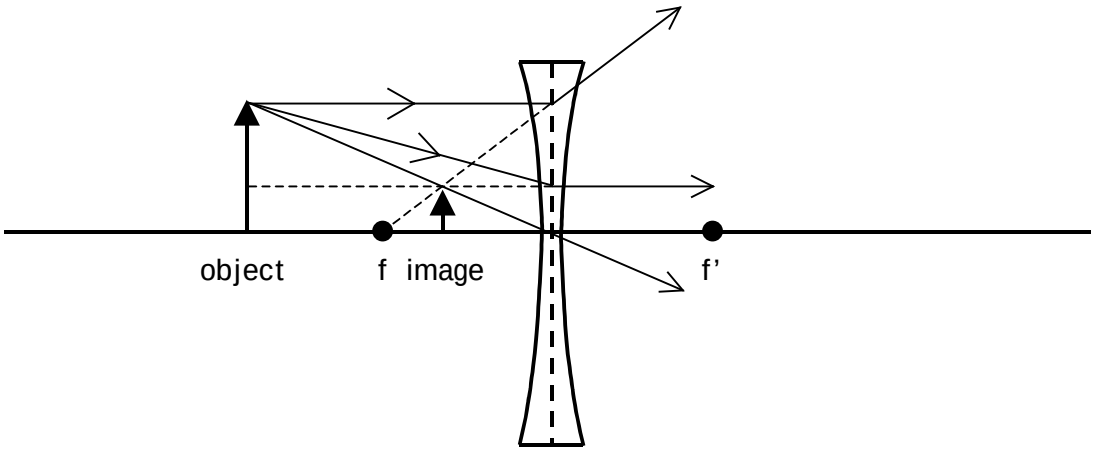
The first person to see Sarah is **Rajiv**.

Marking Scale	
4 marks	Appropriate procedure and correct answer (complete diagram of field vision not required.)
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as incomplete diagram.
2 marks	Appropriate procedure with a major error (e.g. correct diagram but incorrect response).
1 mark	Partially appropriate procedure with a major error.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

Question 13

Example of an appropriate procedure

Solution



Marking Scale	
4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer due to poorly drawn lines or angles.
2 marks	Appropriate procedure with a major error (e.g. one ray is drawn incorrectly, incorrect image or no image).
1 mark	Partially appropriate procedure with a major error.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

Question 14

Example of an appropriate procedure

M = 3

F = 15 cm

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$$

$$M = \frac{-d_i}{d_o}$$
$$3 = \frac{-d_i}{d_o}$$
$$3\,d_o = -d_i$$
$$-3\,d_o = d_i$$
$$\frac{1}{15} = \frac{-1}{3\,d_o} + \frac{1}{d_o}$$
$$\frac{1}{15} = \frac{-1}{3\,d_o} + \frac{3}{3\,d_o}$$
$$\frac{1}{15} = \frac{2}{3\,d_o}$$
$$d_o = \frac{30}{3}$$
$$d_o = 10 \text{ cm}$$

Answer

The stamp is **10 cm** from the magnifying glass.

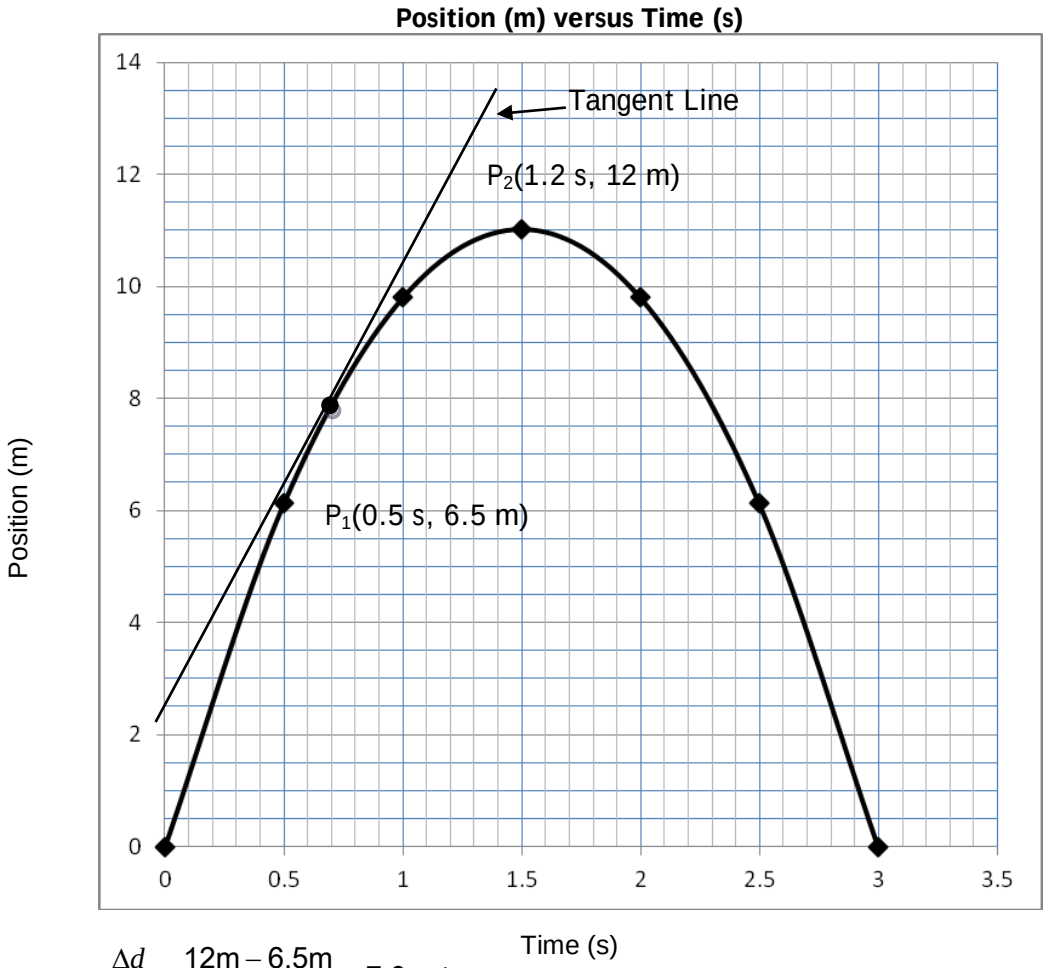
Marking Scale	
4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate procedure with a major error.
1 mark	Partially appropriate procedure with a major error.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

Question 15

Example of an appropriate procedure

Procedure

1. Draw tangent line.
2. Identify two points on tangent line.



$$v_{\text{instantaneous}} = \frac{\Delta d}{\Delta t} = \frac{12\text{m} - 6.5\text{m}}{1.2\text{s} - 0.5\text{s}} = 7.9\ \textbf{m/s}$$

Answer

The instantaneous speed of the ball at 0.75 seconds is **7.9 m/s**. *(Accept answers between 7.0 and 9.0 m/s)*

Marking Scale	
4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate procedure with a major error (e.g. does not read correct values from the graph).
1 mark	Partially appropriate procedure with a major error.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

Question 16

Example of an appropriate procedure

Variables
v_1 = 18 m/s
a = -9.8 m/s^2
Δd = 14.5 m

Work

$$\Delta d = v_1 \Delta t + \frac{1}{2} a \Delta t^2$$

$$\frac{1}{2} a \Delta t^2 + v_1 \Delta t - \Delta d = 0$$

$$\frac{1}{2} (-9.8)\, \Delta t^2 + 18 \Delta t - 14.5 = 0$$

$$\Delta t = \frac{-b \pm \sqrt{b^2 - 4(-4.9)\,(-14.5)}}{2(-4.9)}$$

$$\Delta t = \frac{-18 \pm \sqrt{18^2 - 4(-4.9)\,(-14.5)}}{2(-4.9)}$$

Δt = 1.2 seconds and 2.5 seconds

Answer

The rocket will be located at 14.5 m above the ground at the following time(s):
1.2 seconds and 2.5 seconds.

Marking Scale	
4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate procedure with a major error (e.g. provides only one correct time).
1 mark	Partially appropriate procedure with a major error.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

**** Significant figures will be evaluated.***

Question 17

Example of an appropriate procedure

v_1 = 80.0 m/s
θ_1 = 13.0°

v_{1x} = 80 m/s cos 13.0° = 77.9 m/s
v_{1y} = 80 m/s sin 13.0° = 18.0 m/s

$$\Delta d = v_1 \Delta t + \frac{1}{2} a (\Delta t)^2$$

-5.00 m = (18.0) Δt – 4.9 $(\Delta t)^2$

Quadratic formula

4.9 $(\Delta t)^2$ – (18.0) Δt – 5.00 = 0

a = 4.9 b = -18.0 c = -5.00

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$t = \frac{-(-18.0) \pm \sqrt{(-18.0)^2 - 4\,(4.9)(-5.00)}}{2\,(4.9)}$$

t = 3.93 s

Horizontal distance

$$v_x = \frac{\Delta d}{\Delta t}$$

$$\Delta d = v_x\, \Delta t$$

Δd = (77.9) (3.93) = 307 m

Difference of distance 325 – 307 = 18 m

Answer

The ball landed **18 m** from the flag.

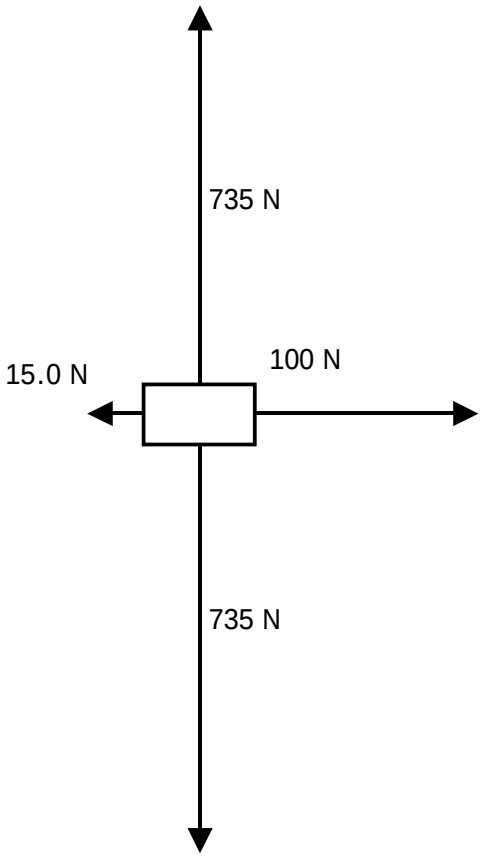
Marking Scale	
5 marks	Appropriate procedure and correct answer.
4 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
3 marks	Appropriate procedure with a major error.
2 marks	Partially appropriate procedure with a major error.
1 mark	Incomplete procedure (e.g. only one correct step in the procedure).
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

Question 18

Example of an appropriate procedure

m = 75.0 kg
$F_{applied}$ = 100 N
$F_{friction}$ = 15.0 N

$Fg = m \bullet g$
$= 75.0 \text{ kg} \bullet 9.8 \text{ m/s}^2$
$= 735 \text{ N}$



Marking Scale	
4 marks	Appropriate procedure and correct answer. Draws all 4 vectors.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement and 3 vectors correctly drawn.
2 marks	Appropriate procedure with a major error (e.g. only draws 2 vectors).
1 mark	Partially appropriate procedure with a major error (e.g. only draws 1 vector).
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

Question 19

Example of an appropriate procedure

F_{wind} = 22 500 N [W 15.0° N]

F_{wx} = 22 500 cos 15.0°
F_{wx} = 21 733 N [West]

F_{wy} = 22 500 sin 15.0°
F_{wy} = 5 823 N [North]

F_{Ax} = 8 750 N [East]
F_{Ay} = 0 N

F_{Bx} = 0 N
F_{By} = 8 750 N [South]

F_{xnet} = 21 733 – 8 750
F_{xnet} = 12 983 N [West]

F_{ynet} = 21 733 – 8 750
F_{ynet} = 2 926 N [South]

$F_{net}^2 = F_{xnet}^2 + F_{ynet}^2$
$F_{net}^2 = (12\ 983)^2 + (2\ 926)^2$
F_{net} = 13 309 N

$\tan \theta = (2\ 926/12\ 983)$
$\theta = \tan^{-1}(1\ 926/13\ 983)$
$\theta = 12.7°$

F_{net} = 13 309 N [W 12.7° S]

Force needed to oppose this and bring the scenario to equilibrium would be in the opposite direction:

F_{eq} = 13 309 N [W 12.7° S]
$F_{eq} = 1.33 \times 10^4$ N [E 12.7° N]

Answer
The force needed to bring the system into equilibrium is
$F_{eq} = 1.33 \times 10^4$ N [East 12.7° North].

Marking Scale	
5 marks	Appropriate procedure and correct answer.
4 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement, or does not determine equilibrium force.
3 marks	Appropriate procedure with a major error (e.g. finds magnitude only).
2 marks	Partially appropriate procedure.
1 mark	Incomplete procedure (e.g. only one correct step in the procedure).
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

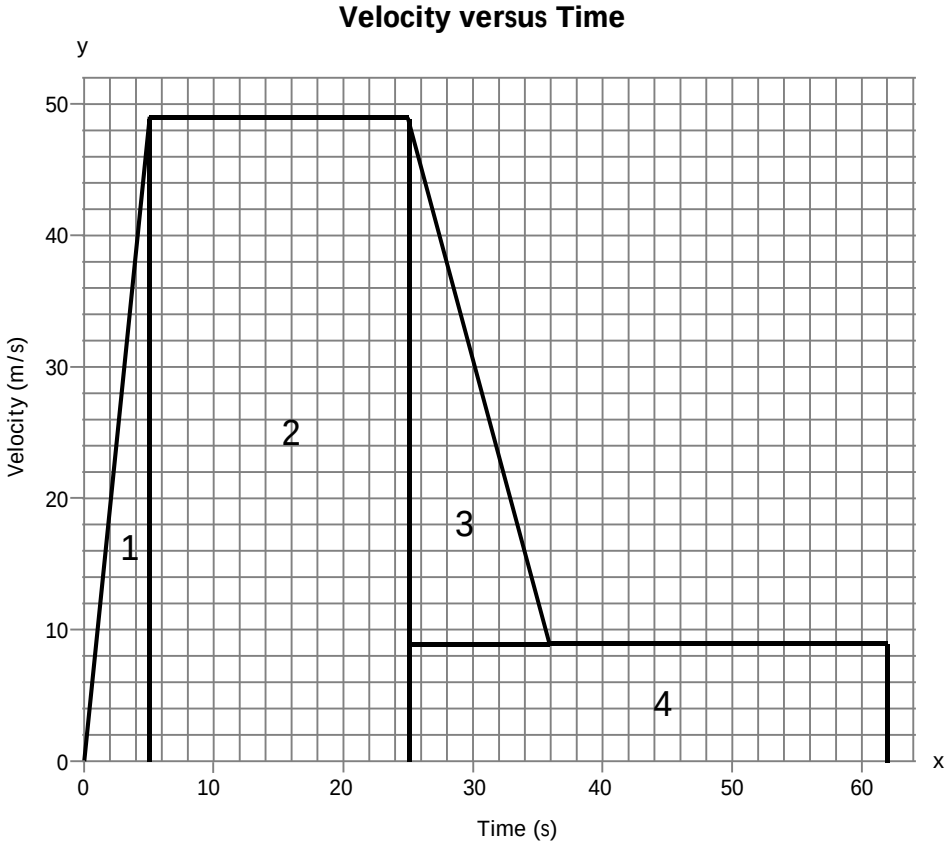
**** Significant figures will be evaluated.***

Question 20

Example of an appropriate procedure

Area under v-t graph is displacement. Areas below graph must be added together.
0s < t < 5s

d_1 = ½ base × height = ½(5 s)(49 m/s) = 122.5 m
d_2 = base × height = (20 s)(49 m/s) = 980 m
d_3 = ½ base × height = ½(11 s)(40 m/s) = 220m
d_4 = base × height = (37 s)(9 m/s) = 333 m
$d_t = d_1 + d_2 + d_3 + d_4$ = 1655.5 m



Answer

The height of the airplane when she started her jump was **1655.5 m**.

Marking Scale	
4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate procedure with a major error (e.g. incorrect calculation of areas).
1 mark	Partially appropriate procedure with a major error.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

Question 21

Example of an appropriate procedure
(May also solve using total energy.)

Step 1

Distance travelled from the top of the incline

Length of the ramp left to travel at height of 1.5 m

$$\frac{1.5}{\sin 23^\circ} = 3.84 \text{ m}$$

Δd = length of the total ramp – length of the ramp left to travel at height of 1.5 m
= 5.5 – 3.84
= 1.66 m

Step 2

Acceleration on ramp

$v_1 = 0$
$v_2 = 3.0$ m/s
$\Delta d = 1.66$ m

$$v_2^2 = v_1^2 + 2a\Delta d$$

$$a = \frac{v_2^2}{2\Delta d} = \frac{3.0^2}{2(1.66)} = 2.71 \text{ m/s}^2$$

Step 3

$F_{net} = F_{parallel} - F_f$
$ma = mg\sin\theta - F_f$
$F_f = 6.7(9.8)\sin 23^\circ - 6.7(2.71)$
= 7.5 N

Answer

The force of friction is **7.5 N.**

Marking Scale	
5 marks	Appropriate procedure and correct answer.
4 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
3 marks	Appropriate procedure with a major error (e.g. determines acceleration on the ramp only).
2 marks	Partially appropriate procedure with a major error (e.g. only finds distance object must travel).
1 mark	Incomplete procedure (e.g. only one correct step in the procedure).
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer.

Marking Guide for Significant Figures (*for Questions 11, 16 and 19*)

Marking Scale	
3 marks	Appropriate and consistent use of significant figures for all questions evaluated.
2 marks	Appropriate use of significant figures for 2 questions.
1 mark	Appropriate use of significant figures for 1 question.
0 marks	Inappropriate use of significant figures for all questions.

Appendix

Feedback Questionnaire

Physics – Cycle 2, Year 3 (Secondary 5)

Theory Examination – PHY-500.A03 — June 2012

Circle the number that corresponds to your opinion.

4 = Very satisfied 3 = Satisfied 2 = Not very satisfied 1 = Dissatisfied

Time allotted for this examination	4	3	2	1
Relevance of context to students' grade level	4	3	2	1
Level of difficulty	4	3	2	1
Evaluation tools	4	3	2	1
Overall quality of the *Administration and Marking Guide*	4	3	2	1

Comments:

_____

_____

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List any errors or omissions:

_____

_____

_____

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_____

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