GRICS

554-534

Physics

# Comprehensive Exam
**Number 56**

# GUIDE

Secondary 5

September, 2006

Youth Sector General Education

## 1. GENERAL INFORMATION

1.1 Program: Physics, Secondary V

1.2 Origin: Mathematics and Science & Technology Committee, 2006

Computerization and graphics: Design Team and
Martine Sanscartier, Société GRICS
Revision : Patricia Juliano, BIM, Société GRICS

1.3 Time allotted: 2 hours 30 minutes

1.4 Number of questions: 25 distributed as follows:
15 multiple-choice questions
10 extended-response questions

1.5 Authorized materials:
- drawing instruments, graph paper
- list of formulas and quantities included
- scientific calculator with or without a graphic display

## 2. DESCRIPTION OF EXAM

The following table matches each of the examination questions with the corresponding dimension of the definition of the domain that was used for the examination.

**Exam Specifications**

| Modules / Skill | Nature of Light 44% | Mechanics 56% |
|---|---|---|
| Mastery of Concepts 32% | 1, 2, 3, 4 | 8, 9, 10, 11 |
| Mastery of Applications 40% | 5, 6, 7, 16 | 12, 13, 14, 15, 20, 21 |
| Mastery of Problem-Solving Techniques 28% | 17, 18, 19 | 22, 23, 24, 25 |

These percentages have been derived based on the marks allotted for each question.

## ITEM SPECIFICATIONS

| Question | | MOD.TO.IO | T | S | D |
|---|---|---|---|---|---|
| Part A | | | | | |
| 1 | [2171] | M01.01.03 | M | C | E |
| 2 | [2172] | M01.02.05 | M | C | E |
| 3 | [2173] | M01.03.03 | M | C | E |
| 4 | [2174] | M01.01.01 | M | C | E |
| 5 | [2175] | M01.03.04 | M | A | M |
| 6 | [2176] | M01.05.02 | M | A | M |
| 7 | [2177] | M01.04.04 | M | A | M |
| 8 | [2178] | M03.01.05 | M | C | M |
| 9 | [2179] | M03.05.03 | M | C | M |
| 10 | [2180] | M03.06.07 | M | C | M |
| 11 | [2181] | M03.01.06 | M | C | M |
| 12 | [2182] | M03.03.09 | M | A | E |
| 13 | [2183] | M03.04.02 | M | A | M |
| 14 | [2184] | M03.02.04 | M | A | M |
| 15 | [2185] | M03.03.02 | M | A | M |
| Part B | | | | | |
| 16 | [2186] | M01.05.04 | E | A | M |
| 17 | [2187] | M01.03.07 | E | P | M |
| 18 | [2188] | M01.05.13 | E | P | M |
| 19 | [2189] | M01.05.07 | E | P | D |
| 20 | [2190] | M03.02.03 | E | A | M |
| 21 | [2191] | M03.03.02 | E | A | M |
| 22 | [2192] | M03.03.05 | E | P | D |
| 23 | [2193] | M03.05.05 | E | P | M |
| 24 | [2194] | M03.06.04 | E | P | D |
| 25 | [2195] | M03.04.08 | E | P | D |

Legend:

MOD : Modules
- M01: Nature of Light
- M03: Mechanics

TO : Terminal objective

IO : Intermediate objective

T : Type
- M: multiple choice
- E: extended answer (constructed response)

S : Skill
- C: Mastery of Concepts
- A: Mastery of Applications
- P: Mastery of Problem-Solving Techniques

D : Level of difficulty
- E: Easy
- M: Medium
- D: Difficult

## 3- CORRECTION KEY

### Part A

4 marks or 0 marks

1 B

2 A

3 C

4 B

5 C

6 C

7 D

8 A

9 C

10 A

11 A

12 A

13 D

14 D

15 B

## GUIDELINES FOR CORRECTING CONSTRUCTED-RESPONSE QUESTIONS

The marking scale for correcting the answers to the constructed-response 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.

Constructed-response questions usually consist of two parts: the **procedure** used to solve the problem and the **answer**. Thus, a constructed-response 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.

**Do not penalize students for having used the incorrect number of significant figures.**

## Part B

16 **Example of an appropriate and complete solution**

$$\frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i}$$

$f$ = 2.0 cm

$d_o$ = 2.1 cm

$$\frac{1}{2.0} = \frac{1}{2.1} + \frac{1}{d_i}$$

$d_i$ = 42 cm

**Answer:** The lens is **42 cm** from the wall.

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it or made an error in units.

2 marks The student chose an appropriate procedure, but made major errors in applying it.

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

17 **Example of an appropriate and complete solution**

To reflect all of the light from the surface, the angle of incidence at point P, ∠A, must be equal to or greater than the critical angle.

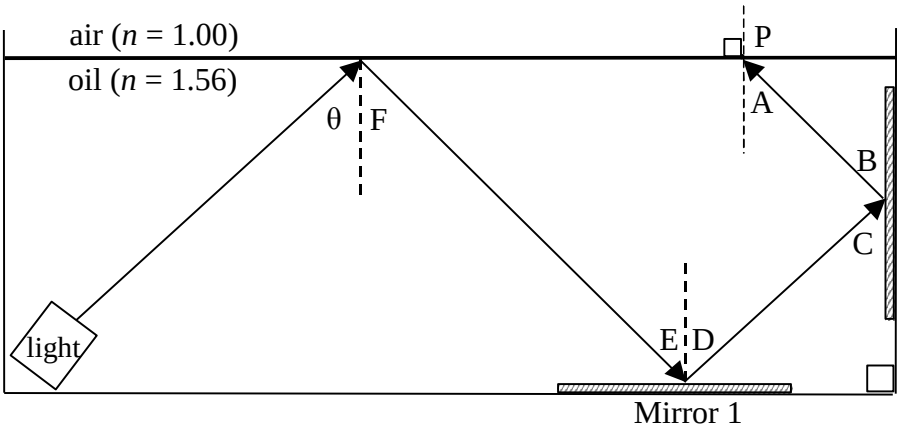
Find the critical angle:

$n_1 = n_{oil} = 1.56$
$n_2 = n_{air} = 1.00$
$\theta_1 = \theta_c = \angle A$
$\theta_2 = 90°$

$n_1 \sin\theta_1 = n_2 \sin\theta_2$
$1.56 \times \sin A = 1.00 \times \sin 90$
$\sin A = \frac{1.00 \times \sin 90}{1.56}$
$= 39.9°$

Considering the law of reflection and the congruence of alternate interior angles:

m ∠A = m ∠B = m ∠C = m ∠D = m ∠E = m ∠F = θ




**Answer:** The minimum angle of incidence, θ, is **39.9°**.

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it.

2 marks The student chose an appropriate procedure, but made major errors in applying it. (e.g., Student determined critical angle but did not consider the reflection to get to point P.)

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

18 **Example of an appropriate and complete solution**

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

$$\frac{1}{7.0\text{ cm}} + \frac{1}{d_i} = \frac{1}{2.0\text{ cm}} \qquad d_i = 2.8\text{ cm}$$

$$\frac{h_i}{h_o} = - \frac{d_i}{d_o}$$

$$h_i = -d_i \times \frac{h_o}{d_o}$$

$$h_i = -2.8\text{ cm} \times \frac{4.0\text{ cm}}{7.0\text{ cm}} \qquad h_i = -1.6\text{ cm}$$

**Answer:** The height of the image is **1.6 cm**.
Accept **-1.6 cm**.

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it.

2 marks The student chose an appropriate procedure, but made major errors in applying it.

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

19 **Example of an appropriate and complete solution**

$M = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$

$M = -3$ because the image is real.

$M = -\frac{d_i}{d_o}$ for converging lenses

$-3 = -\frac{d_i}{d_o}$ Therefore, $d_i = 3d_o$

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

$$\frac{1}{20.0} = \frac{1}{d_o} + \frac{1}{3d_o}$$
$$= \frac{3}{3d_o} + \frac{1}{3d_o}$$
$$= \frac{4}{3\,d_o}$$
$$20.0 = \frac{3}{4} d_o$$
$$d_o = 26.7 \text{ cm}$$

**Answer:** The object must be **26.7 cm** from the lens to create an image 3 times larger than the object.

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it.

2 marks The student chose an appropriate procedure, but made major errors in applying it. (e.g., Student did not use the negative in the equation $\left(-\frac{d_i}{d_o}\right)$.

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

20 **Example of an appropriate and complete solution**

Resultant Force Component Calculation:

$F_{3_x}$ = 20 sin 60° = 17.3 N [W]
$F_{3_y}$ = 20 cos 60° = 10 N [N]

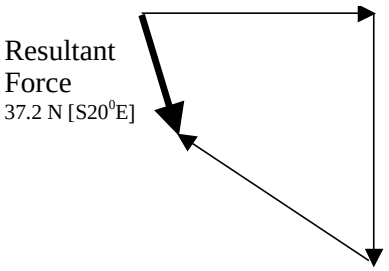
$F_x = F_{3_x} + F_1 = 30 - 17.3 = 12.7$ N [E]
$F_y = F_{3_y} + F_2 = 10 - 45 = 35$ N [S]

$$F_t = \sqrt{F_x^2 + F_y^2}$$
$$= \sqrt{12.7^2 + 35^2}$$
$$= \sqrt{161 + 1225}$$
$$= \sqrt{1386}$$
$$= 37.2 \text{ N}$$

Resultant Direction Component Calculation:

$$\text{Tan } \theta = \frac{12.7}{35}$$
$$= 0.3629$$

$$\theta = \tan^{-1} 0.3629$$
$$= 19.9^{\,0}$$




**Answer:** The equilibrium force is **37 N [N20°W] or 37 N [W70°N]**

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it.

2 marks The student chose an appropriate procedure, but made major errors in applying it. (e.g., Student found the net force.)

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

21 **Examples of appropriate and complete solutions**

$v_1 = 12.0$ m/s
$\Delta d = 4.0$ m
$a = -9.8$ m/s$^2$
$\Delta t$ = ? | Given

Example 1

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

$$4.0 = (12.0)\,\Delta t + \frac{1}{2}(-9.8)\,(\Delta t)^2$$

$$0 = -4.9(\Delta t)^2 + (12.0)\,\Delta t - 4.0$$

$\Delta t$ =0.398 s or 2.051 s

Example 2

$$v_2^2 = v_1^2 + 2a\,\Delta d$$
$$= 12.0^2 + 2\,(-9.8)(4.0)$$
$$= 65.6$$
$$v_2 = \pm\sqrt{65.6}$$
$$= \pm\ 8.1 \text{ m/s}$$

$$v_2 = v_1 + a\Delta t$$
$$\Delta t = \frac{(v_2 - v_1)}{a}$$
$\Delta t$ = 0.398 s or 2.051 s

**Answer:** The keys were in the air for **2.1 s**.

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it.

2 marks The student chose an appropriate procedure, but made major errors in applying it. (e.g., Student chose the incorrect time.)

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

22 **Examples of appropriate and complete solutions**

Example 1

Aeron will run 5 m farther than Cynthia. Therefore,

$$\Delta d_A = \Delta d_C + 5.00$$

$$\Delta t_A = \frac{\Delta d_C + 5.00}{v_A}$$

$$\Delta t_C = \frac{\Delta d_C}{v_C}$$

When Aeron catches Cynthia they will both have run for an equal amount of time, so …

$$\frac{\Delta d_C}{v_C} = \frac{\Delta d_C + 5.00}{v_A}$$

$$\frac{\Delta d_C}{7.00} = \frac{\Delta d_C + 5.00}{9.00}$$

$$9.00\Delta d_C = 7.00(\Delta d_C + 5.00)$$

$$9.00\Delta d_C = 7.00\Delta d_C + 35.0$$

$$2.00\Delta d_C = 35.0$$

$$\Delta d_C = 17.5 \text{ m}$$

$$\Delta d_A = 17.5 \text{ m} + 5.00 \text{ m}$$

$$= 22.5 \text{ m}$$

Example 2

Aeron must make up a difference of 5.00 m running 2.00 m/s faster than Cynthia.

Find the time it takes Aeron to do this:

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

$$= \frac{5.00}{2.00}$$

$$= 2.50 \text{ s}$$

Find the distance Aeron will run:

$$\Delta d = v \times \Delta t$$

$$= 9.00 \times 2.50$$

$$= 22.5 \text{ m}$$

**Answer:** Aeron will run **22.5 m** before she catches up with Cynthia.

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it.

2 marks The student chose an appropriate procedure, but made major errors in applying it.

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

23 **Example of an appropriate and complete solution**

$F_g = mg$

$(1200 + 8 \times 80) \times 9.8 = 18.0 \text{ kN}$

$$W_{output} = F \times \Delta d$$
$$= 18.0 \times 85.5$$
$$= 1540 \text{ kJ}$$

$$Efficiency = \frac{W_{output}}{W_{input}}$$
$$0.10 = \frac{1540 \text{ kJ}}{W_{input}}$$
$$W_{input} = \frac{1540 \text{ kJ}}{0.10}$$
$$= 15\,400 \text{ kJ}$$

$$P = \frac{W}{\Delta t}$$
$$= \frac{15\,400 \text{ kJ}}{120 \text{ s}}$$
$$= 128 \text{ kW}$$

**Answer:** One *Funiculaire* trip to the upper city at full capacity requires **128 kW** of power.

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it.

2 marks The student chose an appropriate procedure, but made major errors in applying it.

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

24 **Example of an appropriate and complete solution**

1. Mechanical energy at A

$$E_{T_A} = mgh + \frac{1}{2}mv^2$$
$$E_{T_A} = 85.0(9.8)(100.0) + \frac{1}{2}(85.0)(3.00)^2$$
$$E_{T_A} = 83\,300 + 382.5$$
$$E_{T_A} = 83\,682.5 \text{ J}$$

2. Mechanical energy at B

$$E_{T_B} = mgh + \frac{1}{2}mv^2$$
$$E_{T_B} = 85.0(9.8)(60.0) + \frac{1}{2}(85.0)(10.0)^2$$
$$E_{T_B} = 49\,980 + 4250$$
$$E_{T_B} = 54\,230 \text{ J}$$

3. Energy lost to friction

$$E_{lost} = E_{T_A} - E_{T_B}$$
$$= 83\,682.5 - 54\,230$$
$$= 29\,452.5 \text{ J}$$

4. Force of friction

$$W = F \bullet \Delta d$$
$$F_f = \frac{W}{\Delta d}$$
$$= \frac{2945.2}{300.0}$$
$$= 98.2 \text{ N}$$

**Answer:** The average force of friction applied to Pat is **98.0 N.**
Accept **–98.2 N** also.

**Do not** penalize students for having used the incorrect number of significant figures.

| | |
|---|---|
| 4 marks | The student chose an appropriate procedure and applied it correctly; the final answer is correct. |
| 3 marks | The student chose an appropriate procedure, but made minor errors in applying it. |
| 2 marks | The student chose an appropriate procedure, but made major errors in applying it. |
| 1 mark | The student's procedure was partially appropriate, i.e. at least one step was relevant and correct. |
| 0 marks | The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance. |

25 **Examples of appropriate and complete solutions**

Let $x$ represent the mass of the car and driver only.

Situation 1

(Car + driver)

$$a = \frac{\Delta v}{\Delta t}$$
$$= \frac{20.0}{10.0}$$
$$= 2.00 \text{ m/s}^2$$
$$F_{net} = ma$$
$$F_a = x \times 2.00$$
$$F_a = 2.00\ x$$

Situation 2

(Car + driver + passengers)

$$a = \frac{\Delta v}{\Delta t}$$
$$= \frac{15.0}{10.0}$$
$$= 1.50 \text{ m/s}^2$$
$$F_{net} = ma$$
$$F_a = (x + 284)a$$
$$F_a = (x + 284) \times 1.50$$
$$F_a = 1.50\ x + 426$$

Since $F_a$ is the same for both situations:

$2.00\ x = 1.50\ x + 426$
$0.50\ x = 426$
$x = 852$ kg

**Answer:** The combined mass of the car and driver is **852 kg**.

**Do not** penalize students for having used the incorrect number of significant figures.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct.

3 marks The student chose an appropriate procedure, but made minor errors in applying it.

2 marks The student chose an appropriate procedure, but made major errors in applying it.

1 mark The student's procedure was partially appropriate, i.e. at least one step was relevant and correct.

0 marks The student showed no work (even if the answer is correct) or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

GRICS

554-534

Physics

# Comprehensive Exam
**Number 56**

## Question Booklet

Secondary 5

September 2006

Youth Sector General Education

## INSTRUCTIONS

1. Write the required information on the title page of the *Answer Booklet*.

2. Answer all 25 questions in the *Answer Booklet*. Each question is worth four marks.

3. You may use drawing instruments, graph paper and a scientific calculator with or without a graphic display.

4. You may refer to the lists of formulas and quantities included in this *Question Booklet*. The use of any other reference material is strictly forbidden.

5. Hand in both the *Question Booklet* and the *Answer Booklet* at the end of the exam session.

Note: Figures are **NOT** necessarily drawn to scale.

Time allotted: 2 hours 30 minutes

## EQUATIONS

### OPTICS

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

$$M = \frac{h_i}{h_o}$$

$$\frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

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

$$P = \frac{1}{f}$$

$$P_t = P_1 + P_2 + ... + P_n$$

### MECHANICS

$$v_{av} = \frac{\Delta d}{\Delta t}$$

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

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

$$v_2 = v_1 + a\Delta t$$

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

$$P = \frac{W}{\Delta t}$$

$$W = F\ \Delta d$$

$$F_E l_E = F_R l_R$$

$$E_g = mgh$$

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

$$F_E \Delta d_E = F_R \Delta d_R$$

$$F = ma$$

$$F_g = mg$$

$$F = kx$$

### MATHEMATICS

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

## PHYSICAL CONSTANTS

| SYMBOL | QUANTITY | VALUE |
|---|---|---|
| $c$ | Speed of light in a vacuum | $3.00 \times 10^8$ m/s |
| $g$ | Acceleration due to gravity (earth) | 9.8 m/s$^2$ |

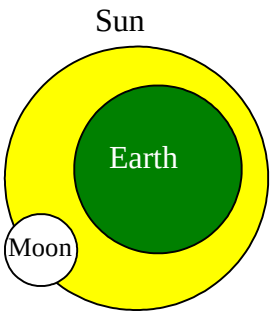
**PART A**

Questions 1 to 15
Blacken the letter that corresponds to your answer in the *Answer Booklet*.

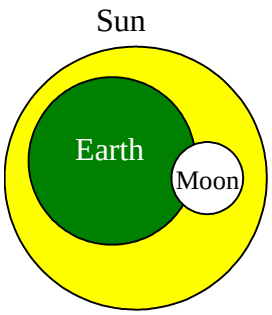
1 In each diagram below, the large circle represents the sun, the small circle represents the moon, and the third circle represents the earth.

**In which diagram would a total lunar eclipse be observed?**

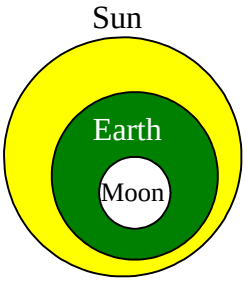
A)



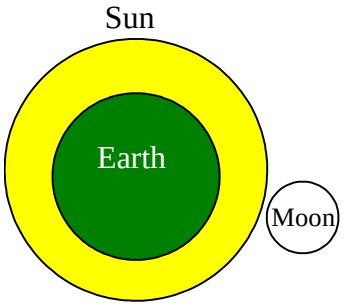

C)




B)

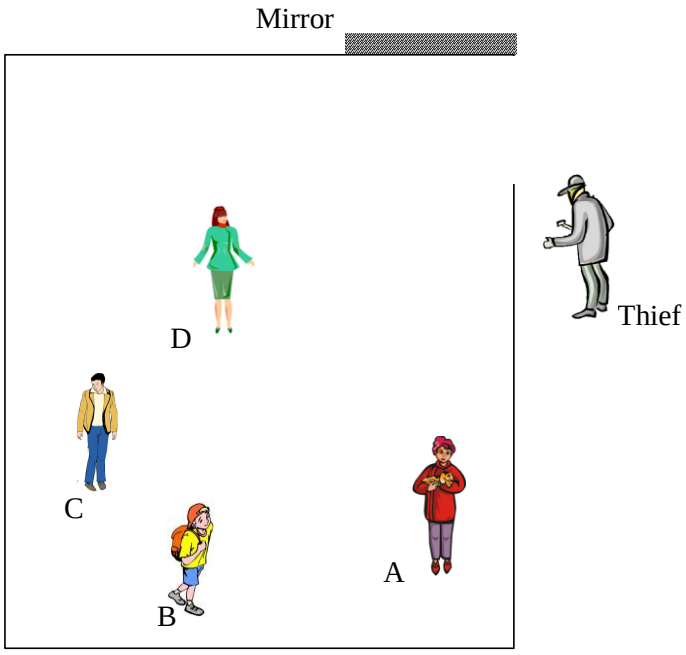



D)



2 Before entering a room, a thief uses a flat mirror that is in the room to check whether it is empty and safe for him to enter.

**Which person cannot be seen by the thief from his current position?**




A) Person A
B) Person B
C) Person C
D) Person D

3 Sandra wore a red and white shirt to a party, at which all the lights were covered with blue filters.

**In this light, what colour did her shirt appear to be?**

A) All blue
B) All black
C) Black and blue
D) Red and blue

4 A pencil is held 30 cm from the front of a pinhole camera. The length of the camera is 20 cm.

**Which of the following describes the image of the pencil seen inside the pinhole camera?**

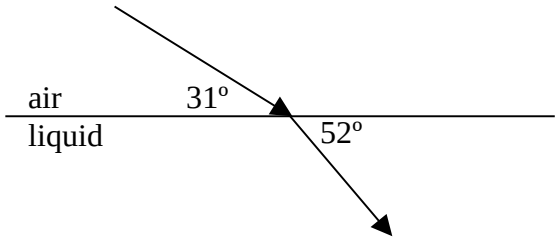
A) Inverted and larger than the pencil

B) Inverted and smaller than the pencil

C) Upright and larger than the pencil

D) Upright and smaller than the pencil

5 During a recent physics lab, Sam and Simon took measurements of a light ray passing from air into a liquid. These measurements are shown below.




**What is the index of refraction for this liquid?**

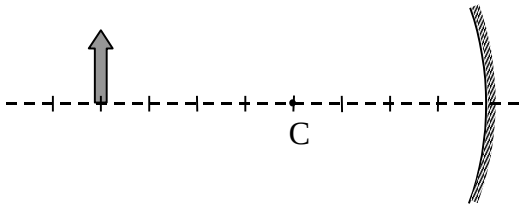
A) 0.65

B) 0.72

C) 1.4

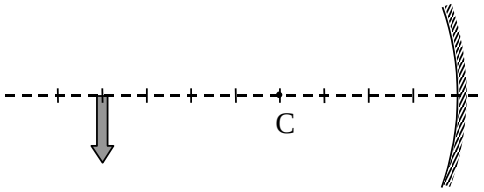
D) 1.5

6 The diagram below shows an object placed in front of a concave mirror. The concave mirror has a centre of curvature at point C.

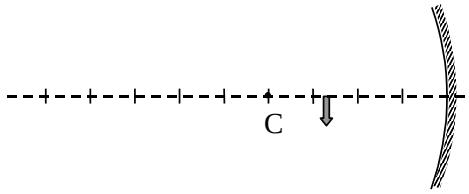



**Which of the following most accurately shows the image that will be created?**

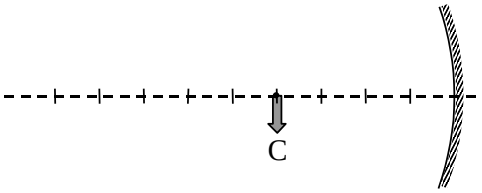
A)



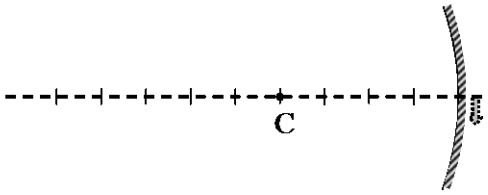

C)




B)




D)

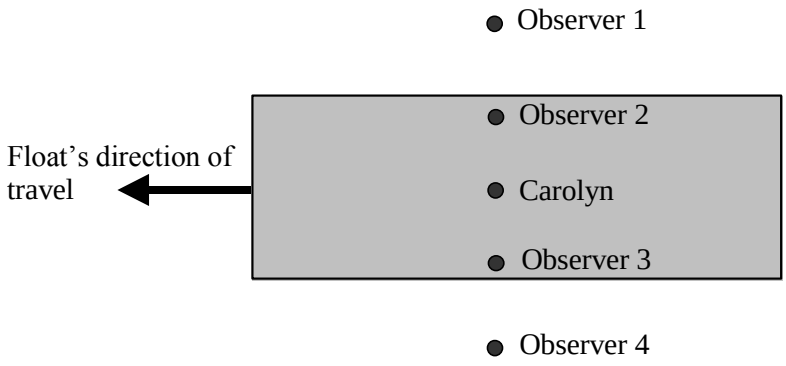


7 As part of an experiment, Justin determined that the focal length of a three-lens system was +4.0 cm. Justin's partner, James, was supposed to record the individual focal lengths of the three lenses. Unfortunately, in his hurry to get to lunch, James only recorded the values for two of the lenses: +40.0 cm and +12.5 cm.

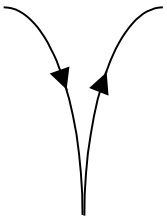
**What was the focal length of the third lens?**

A) –49 cm
B) +2.8 cm
C) +4.0 cm
D) +6.9 cm

8 Carolyn is bouncing a ball on a float in a neighbourhood parade. Four observers are watching her bounce the ball. Observers 1 and 4 are standing on the sidewalk, while observers 2 and 3 are sitting on the float. The diagram below is an aerial view of the float showing Carolyn's position as well as the positions of the four observers.



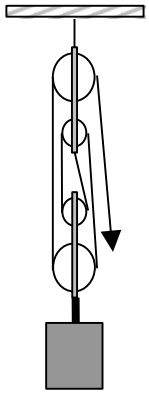

**Which observer views the ball's trajectory as shown below?**



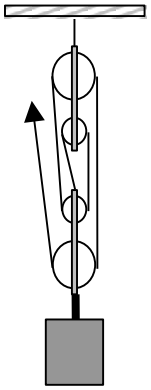
A) Observer 1
B) Observer 2
C) Observer 3
D) Observer 4

9 **Which of the following machines have the same Ideal Mechanical Advantage?**

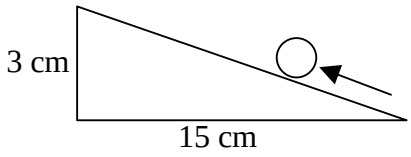
1.



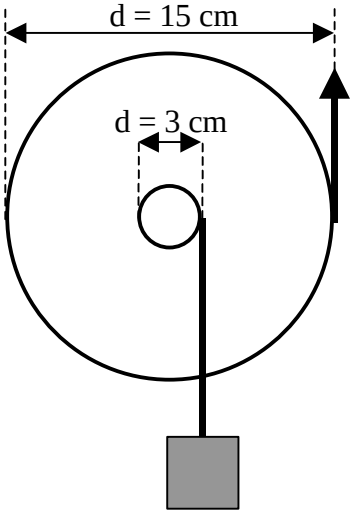
2.



3.




4.




A) 1 and 2

B) 1 and 3

C) 2 and 4

D) 3 and 4

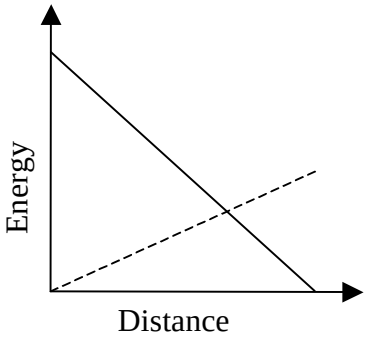
10 A box is released from rest at the top of a ramp and slides down the ramp. There is sufficient friction in the ramp to transform half of the total mechanical energy of the box into heat energy and sound energy as it slides down the ramp.

**Which graph below best shows the kinetic and potential energies as a function of the distance that the box slides down the ramp?**

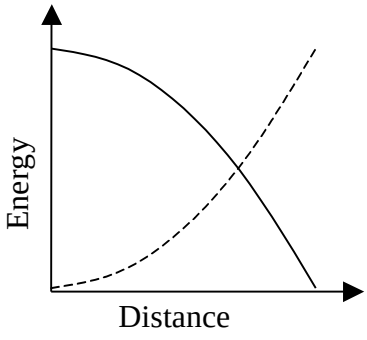
———— Potential Energy

---------- Kinetic Energy

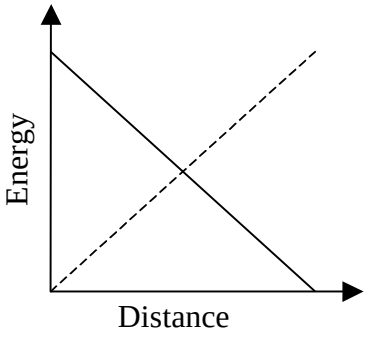
A)



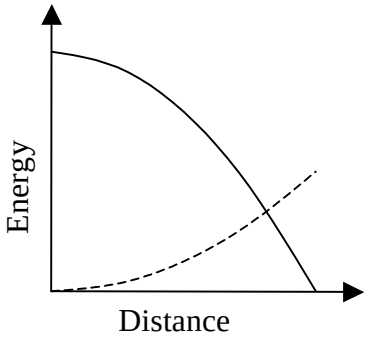

C)




B)




D)



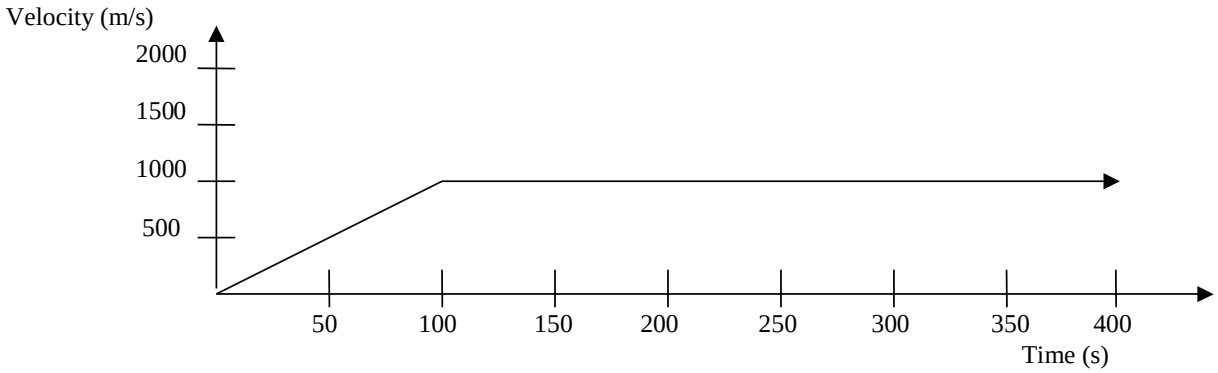
11 To get from his house to the houses of four of his friends, Serge must travel in different directions, as indicated below.

| | |
|---|---|
| Archie: | 4.8 km [N]; 3.2 km [W] |
| Barry: | 20 km [N]; 15 km [S] |
| Chris: | 3 km [N]; 7 km [S45°E] |
| Steve: | 3.5 km [S]; 1 km [E]; 2 km [S] |

**A visit to which friend would result in the greatest total displacement from Serge's house?**

A) Archie
B) Barry
C) Chris
D) Steve

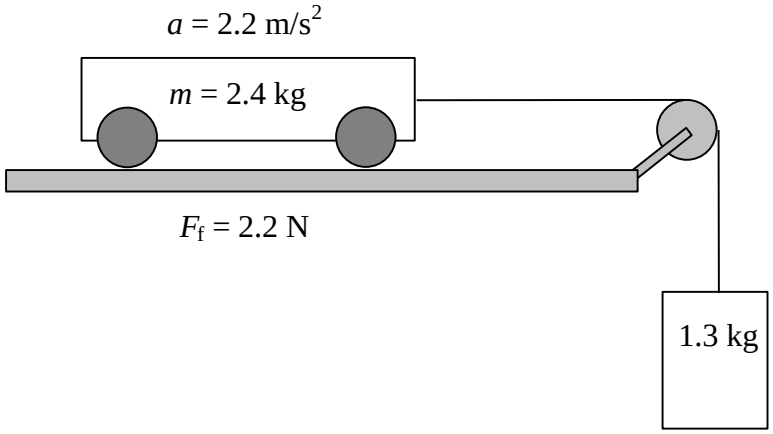
12 The graph below displays the velocity of a body in motion over time.




**How many metres has the body travelled in 5 minutes?**

A) 250 000 m
B) 300 000 m
C) 350 000 m
D) 450 000 m

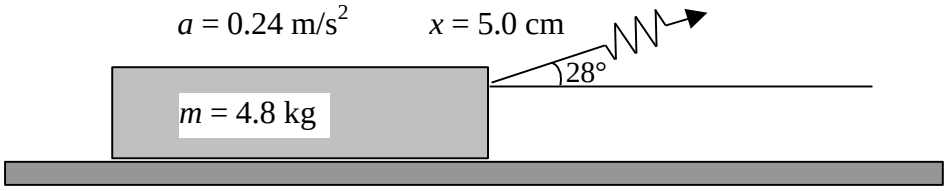
13 Astronauts Zachary and Talia conducted the typical "lab cart" experiment on *Planet X*, where the gravitational field strength is different from that on Earth. The data from their experiment is shown below.




**What is the gravitational field strength on *Planet X*?**

A) 2.8 N/kg
B) 4.6 N/kg
C) 5.8 N/kg
D) 8.0 N/kg

14 Gaby uses a spring attached to a 4.8 kg mass at an angle of 28° to pull it across a desk, causing it to accelerate horizontally at 0.24 m/s$^2$. The extension of the spring is 5.0 cm.
(Assume that friction is negligible.)




**What is the spring constant?**

A) 0.23 N/m
B) 0.26 N/m
C) 23 N/m
D) 26 N/m

15 Pat and Ryan are arguing about who can throw a football higher. Pat decides to throw the ball first and he sends it straight up at a velocity of 32 m/s. Unfortunately, he does not notice a bird flying 25 m above him, and he hits the bird. (Assume air resistance is negligible.)

**At what velocity is the ball travelling at the instant it hits the bird?**

A) 15 m/s
B) 23 m/s
C) 39 m/s
D) 534 m/s

In Part B of the examination you must show all your work. Answer all these questions in the *Answer Booklet*. Show all the work needed to solve the problem: **data given, explanations, formulas** and **calculations**. Then write your answer in the space provided. You will be given no marks if you provide the right answer without showing your work. However, you will be given part marks for work that is partially correct. Where necessary, corrections will take into account the units of measurement.

**PART B**

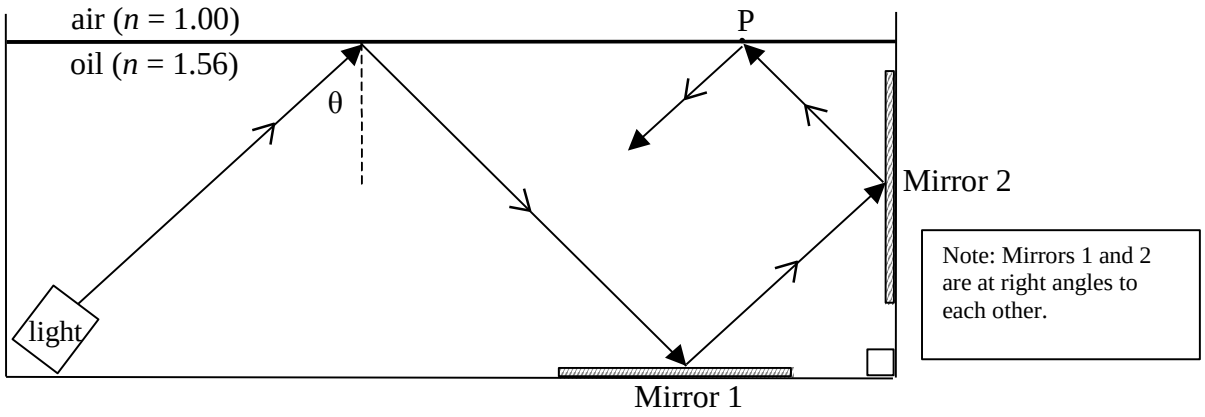
Questions 16 to 25
Answer all these questions in the *Answer Booklet* provided.

16 A child's toy consists of a small light bulb that lights a picture of Scooby Doo. The light from this picture then passes through a convex lens and is projected on the wall. The picture of Scooby Doo is 2.1 cm from the lens, and the focal length of the lens is 2.0 cm. The child holds the toy so that the image of Scooby Doo is perfectly focused on the wall.

**At what distance is the lens from the wall?**

17 Grant decided to build a decorative lamp. He placed a sealed light at the bottom of a glass container filled with a transparent oil ($n$ = 1.56). The bottom of the container is flat and horizontal. Two mirrors are attached to the bottom and to one side of the container, as illustrated.

Grant plans to have the beam of light reflect, in turn, from the surface, from mirror 1, from mirror 2, and then from the surface again. He wants all of the light to remain in the lamp as it reflects from the surface at point P.




**What is the minimum angle of incidence of the initial light beam (angle θ) that will make the light reflect from the surface from point P?**

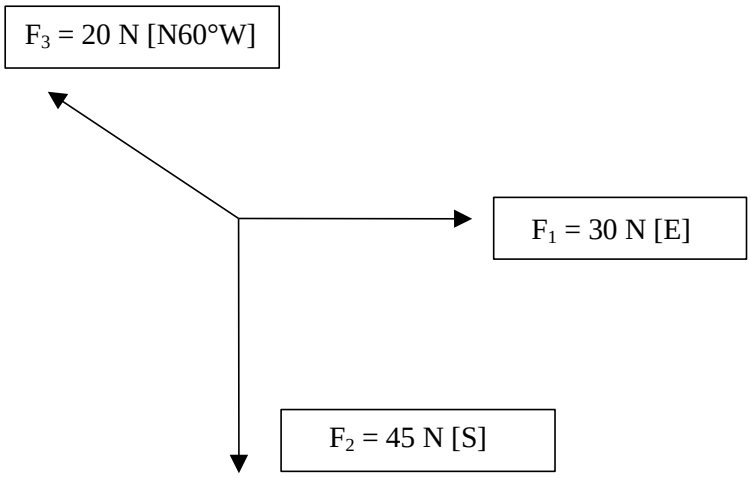
18 A 4.0 cm tall smurf is 7.0 cm away from a converging lens ($f$ = 2.0 cm).

**What is the height of the image formed?**

19 Bobby is having fun with lenses in the physics lab. He discovers that you can project real images onto vertical screens using a converging lens. Using a lens with a focal length of 20.0 cm, he is able to form an image that is 3 times larger than the original object.

How far is the object from the lens?

20 **What additional force (magnitude and direction) is needed to put the following forces in equilibrium?**
(Diagram is not drawn to scale)




21 Mike forgot to leave his wife's keys in their apartment, so he decided to throw them up to her. She was standing on a balcony 4.0 m above him. He threw the keys straight up with a velocity of 12.0 m/s. His wife missed the keys on the way up, but caught them as they were coming down.

**For how many seconds were the keys in the air?**

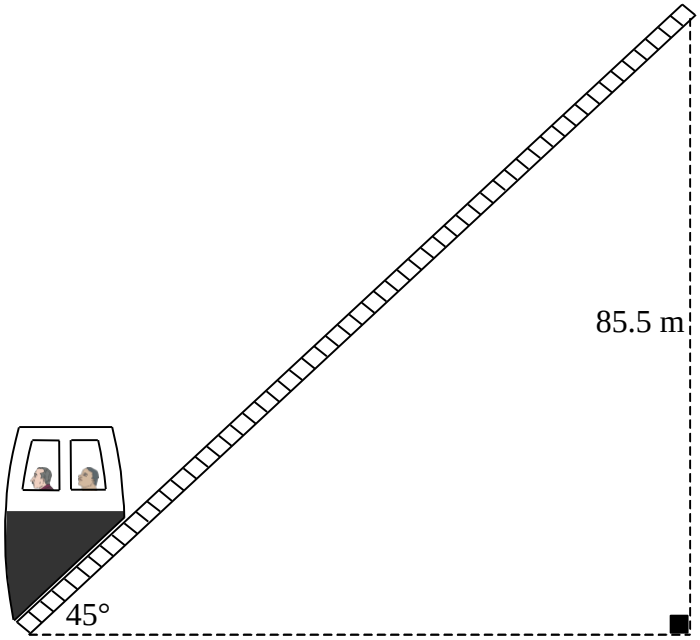
22 Aeron and Cynthia are runners on the school relay team. On the exchange of the baton between them, Aeron enters the exchange zone with a speed of 9.00 m/s. At the same instant, Cynthia is 5.00 metres ahead running with a speed of 7.00 m/s. Each girl runs at a constant speed.

An aerial view of the exchange zone at this instant is shown below.


**How far will Aeron run before she catches up with Cynthia?**

23 The *Funiculaire,* an inclined railway in Quebec City, links the lower city to the upper city, covering a vertical distance of 85.5 m at an inclination of 45°. It takes 2 minutes to make the trip from the lower city to the upper city. The efficiency of the *Funiculaire* is 10%.

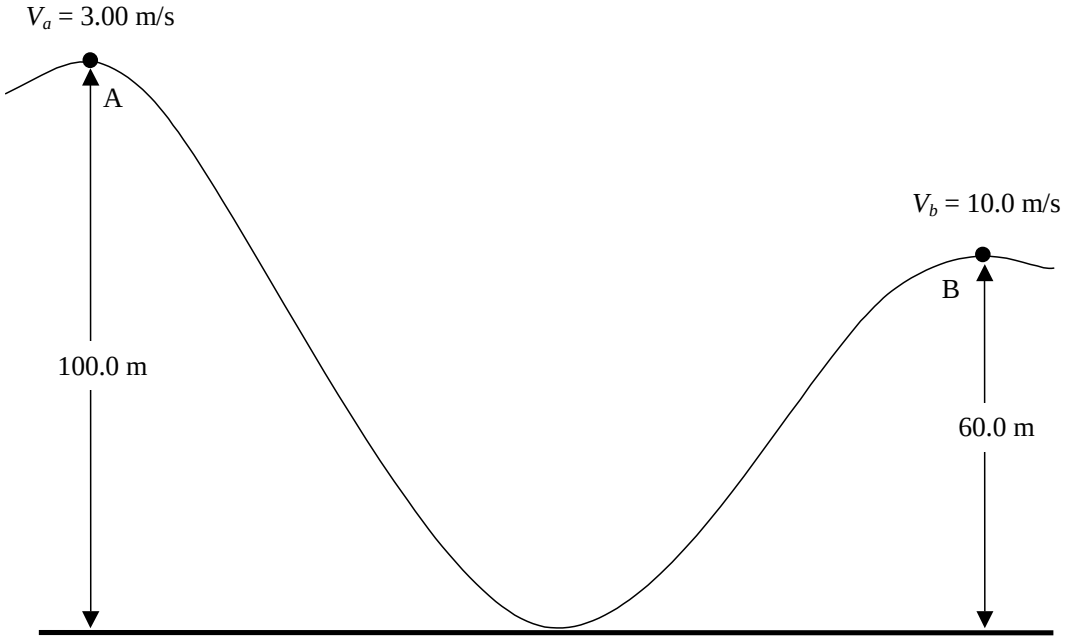
The *Funiculaire,* whose mass is 1200 kg, can hold 8 people, each with an average mass of 80 kg.




**What power is needed for one *Funiculaire* trip to the upper city at full capacity?**

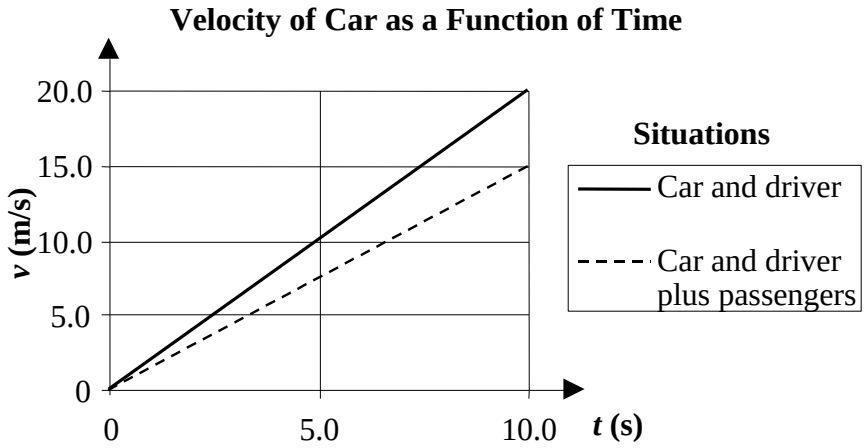
24 Pat, a skier, whose mass is 85.0 kg, crests a hill at point A at a speed of 3.00 m/s. Pat arrives at point B with a speed of 10.0 m/s, having covered a distance of 300.0 m over the trail.

**What is the average force of friction applied to Pat throughout this run?**



25 Kaitlin and Brayden measured the velocity of a car over a period of time, first with only the driver in the car and then with passengers in the car. The passengers added an extra 284 kg of mass. The force applied by the motor was the same for both situations. Friction is negligible.

The data Kaitlin and Brayden collected is presented in the graph below.




**What is the combined mass of the car and driver?**

GRICS

554-534

Physics

# Comprehensive Exam
**Number 56**

## Answer Booklet

Secondary 5

September, 2006

| Student's Name | |
|---|---|
| Group | Date |

Youth Sector General Education

**PART A**

Questions 1 to 15
Blacken the letter that corresponds to your answer.
Each question is worth four marks.

1 [A] [B] [C] [D]

2 [A] [B] [C] [D]

3 [A] [B] [C] [D]

4 [A] [B] [C] [D]

5 [A] [B] [C] [D]

6 [A] [B] [C] [D]

7 [A] [B] [C] [D]

8 [A] [B] [C] [D]

9 [A] [B] [C] [D]

10 [A] [B] [C] [D]

11 [A] [B] [C] [D]

12 [A] [B] [C] [D]

13 [A] [B] [C] [D]

14 [A] [B] [C] [D]

15 [A] [B] [C] [D]

**PART B**

Questions 16 to 25

Each question is worth 4 marks.
Answer all these questions in this *Answer Booklet*.
Write a complete answer for each question, including units of measurement where applicable.
Marks will only be given if you show your work.

Note: **Diagrams have not been drawn to scale**.

16

**SHOW ALL YOUR WORK**

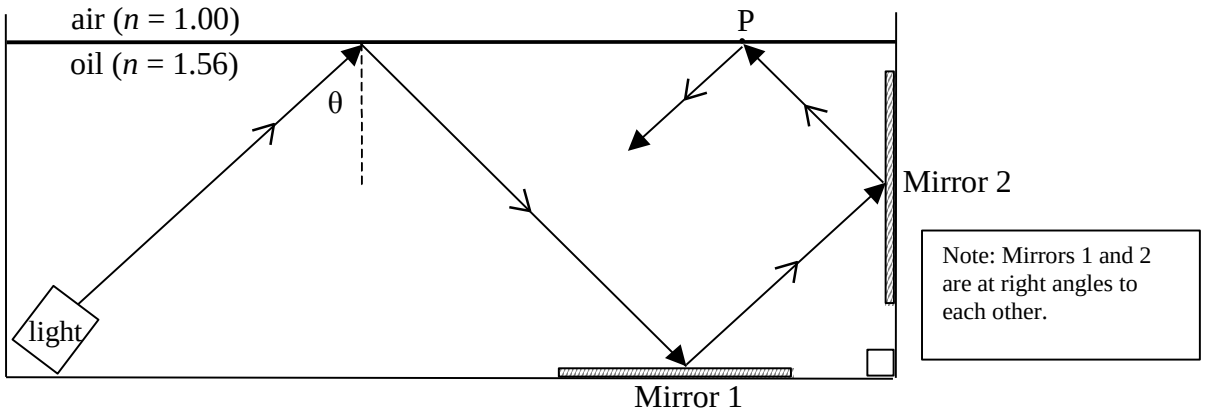
(You must include correct units.)

Answer: The lens is _____ from the wall.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

17

**SHOW ALL YOUR WORK**




(You must include correct units.)

Answer: The minimum angle of incidence, θ, is _____.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

18

**SHOW ALL YOUR WORK**

(You must include correct units.)

Answer: The height of the image is _____.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

19

**SHOW ALL YOUR WORK**

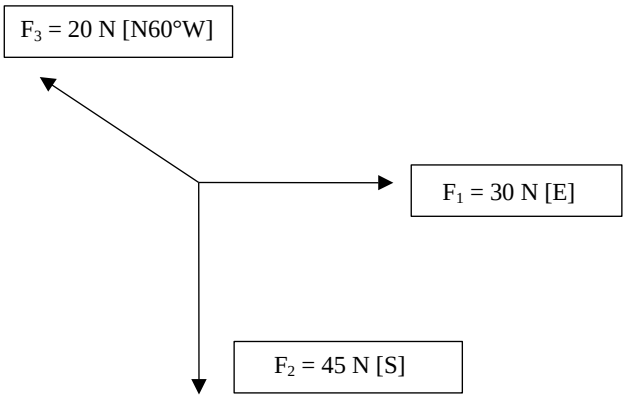
(You must include correct units.)

Answer: The object is _____ from the lens.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

20

**SHOW ALL YOUR WORK**




(You must include correct units.)

Answer: The equilibrium force needed is _____.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

21

**SHOW ALL YOUR WORK**

(You must include correct units.)

Answer: The keys were in the air for _____.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

22

**SHOW ALL YOUR WORK**


(You must include correct units.)

Answer: Aeron will run _____ before she catches up with Cynthia.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

23

**SHOW ALL YOUR WORK**

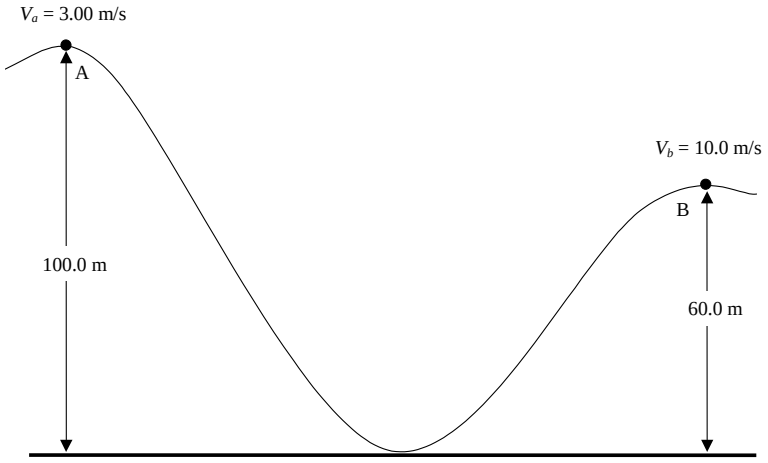
(You must include correct units.)

Answer: One *Funiculaire* trip to the upper city at full capacity requires _____ of power.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

24

**SHOW ALL YOUR WORK**



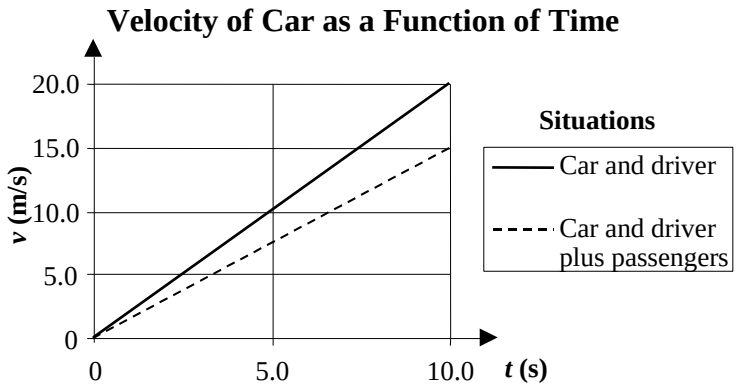

(You must include correct units.)

Answer: The average force of friction applied to Pat is _____.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|

25

**SHOW ALL YOUR WORK**




(You must include correct units.)

Answer: The combined mass of the car and driver is _____.

| 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|