GRICS

554-534

Physics

Comprehensive Exam
Number 52

GUIDE

Secondary 5

September 2002

Youth Sector General Education

1. GENERAL INFORMATION

1.1 Program: Physics, Secondary V

1.2 Origin: Science Coordinating Committee Examination, 2002.

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

1.3 Time allotted: 2 hours 30 minutes

1.4 Number of questions: 27 distributed as follows:
18 multiple choice
9 constructed response

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 36%	1, 2, 4, 5	9, 14, 15, 16, 17
Mastery of Applications 36%	3, 6, 7, 8	10, 11, 12 13, 18
Mastery of Problem-Solving Techniques 28%	19, 20, 21, 22 (3 of 4)	23, 24, 25, 26, 27 (4 of 5)

These percentages have been derived on the basis of the marks allotted for each question.
Although this table indicates that there are 27 questions, the student is required to answer only 25 of them. For questions 19, 20, 21 and 22, the student is required to answer only three of the four. For questions 23, 24, 25, 26 and 27, the student is required to answer four of the five.

ITEM SPECIFICATIONS

Question		MOD.TO.IO	T	S	D
Part A					
1	[2061]	M01.01.01	M	C	E
2	[2062]	M01.02.04	M	C	E
3	[2063]	M01.02.05	M	A	D
4	[2064]	M01.02.06	M	C	E
5	[2065]	M01.03.04	M	C	M
6	[2066]	M01.03.07	M	A	M
7	[2067]	M01.05.01	M	A	M
8	[2068]	M01.05.02	M	A	M
9	[2069]	M03.01.06	M	C	E
10	[2070]	M03.02.03	M	A	M
11	[2071]	M03.02.04	M	A	M
12	[2072]	M03.03.02	M	A	M
13	[2073]	M03.03.03	M	A	M
14	[2074]	M03.04.03	M	C	E
15	[2075]	M03.04.04	M	C	M
16	[2076]	M03.05.01	M	C	M
17	[2077]	M03.06.02	M	C	M
18	[2078]	M03.06.04	M	A	M
Part B					
19	[2079]	M01.04.04	E	P	M
20	[2080]	M01.03.08	E	P	D
21	[2081]	M01.05.07	E	P	D
22	[2082]	M01.05.13	E	P	M
Part C					
23	[2083]	M03.02.08	E	P	D
24	[2084]	M03.03.09	E	P	D
25	[2085]	M03.04.08	E	P	M
26	[2086]	M03.05.05	E	P	M
27	[2087]	M03.06.07	E	P	M

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 D

2 B

3 C

4 C

5 D

6 C

7 A

8 B

9 A

10 C

11 B

12 A

13 B

14 D

15 C

16 C

17 D

18 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.

The answers to constructed-response questions usually consist of two parts: the **procedure** used to solve the problem and the **answers**. 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 is 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.

Part B

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

Optical power of first lens is -2.00 diopters

Optical power of second lens

$$P_2 = \frac{1}{f_2}$$

$$P_2 = \frac{1}{0.200\ \text{m}}$$

$$P_2 = 5.00\ \text{diopters}$$

Optical power of third lens

$P_t = P_1 + P_2 + P_3$

1.5 d = -2.00 d + 5.00 d + P_3

P_3 = -1.50 d

Focal length of third lens

$$f_3 = \frac{1}{P_3}$$

$$f_3 = \frac{1}{-1.50\ \text{d}}$$

$$f_3 = -0.667\ \text{m}$$

Answer: The focal length of the third lens is **-0.667 m** or **-6.67×10^{-1} m**

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 (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly).

2 marks The student chose an appropriate procedure, but made major errors in applying it (i.e. errors relating to methods, rules, laws, systems or theories.) (e.g. Student calculates P_2 and P_3 but fails to convert 20.0 cm to metres.)

1 mark The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly.) (e.g. Student calculates P_2 only.)

0 marks The student showed no work 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 answer**

Angle of refraction of blue light

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

$1.00 \sin 45° = 1.67 \sin \theta_2$

$\sin \theta_2 = \dfrac{1.00 \sin 45°}{1.67}$

$\theta_2 = \sin^{-1}\left(\dfrac{1.00 \sin 45°}{1.67}\right)$

$\theta_2 = 25°$

Angle of refraction for red light

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

$1.00 \sin 45° = 1.61 \sin \theta_2$

$\sin \theta_2 = \dfrac{1.00 \sin 45°}{1.61}$

$\theta_2 = \sin^{-1}\left(\dfrac{1.00 \sin 45°}{1.61}\right)$

$\theta_2 = 26°$

Difference between refracting rays: $26° - 25° = 1°$

Answer: The angle between the two refracted rays is 1°.

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 (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly).

2 marks The student chose an appropriate procedure, but made major errors in applying it (i.e. errors relating to methods, rules, laws, systems or theories). (e.g. Student uses an incorrect index of refraction.)

1 mark The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly) (e.g. Student calculates only one angle.)

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

21 **Example of an appropriate and complete answer**

Distance of image

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

$$\frac{1}{-30.0\text{ cm}} = \frac{1}{50.0\text{ cm}} + \frac{1}{d_i}$$

$$\frac{1}{d_i} = \frac{1}{-30.0\text{ cm}} - \frac{1}{50.0\text{ cm}}$$

$$\frac{1}{d_i} = -0.0533$$

$$d_i = -18.75\text{ cm}$$

Height of image

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

$$\frac{h_i}{15.0\text{ cm}} = -\frac{-18.75\text{ cm}}{50.0\text{ cm}}$$

$$h_i = \frac{18.75\text{ cm} \times 15.0\text{ cm}}{50.0\text{ cm}}$$

$$h_i = 5.63\text{ cm}$$

Answer: The height of the image of the vase is **5.63 cm**.

NOTE A graphical solution is also possible with an acceptable level of accuracy. (e.g. between 5 cm and 6 cm)

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 (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly).

2 marks The student chose an appropriate procedure, but made major errors in applying it (i.e. errors relating to methods, rules, laws, systems or theories). (e.g. Student forgets negative sign in focal length.)

1 mark The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly.)

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

22 **Example of an appropriate and complete answer**

Distance of image

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

$$\frac{1}{12\text{ cm}} = \frac{1}{4.0\text{ cm}} + \frac{1}{d_i}$$

$$\frac{1}{d_i} = \frac{1}{12\text{ cm}} - \frac{1}{4.0\text{ cm}}$$

$$\frac{1}{d_i} = -0.1666$$

$$d_i = -6.0\text{ cm}$$

Magnification

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

$$M = -\frac{-6.0\text{ cm}}{4.0\text{ cm}}$$

$$M = 1.5$$

Answer: The magnification of the image is **1.5**.

NOTE A graphical solution is also possible with an acceptable level of accuracy. (e.g. between 1.3 to 1.7)

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

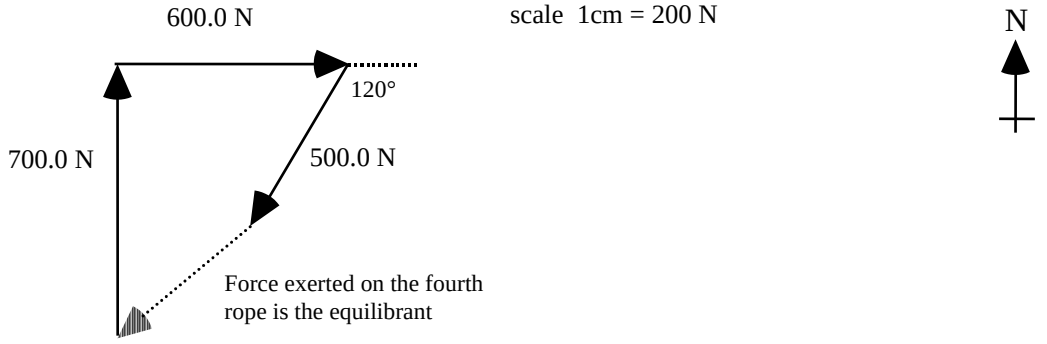
3 marks The student chose an appropriate procedure, but made minor errors in applying it (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly). (e.g. Student used d_i = +6.0 cm instead of –6.0 cm)

2 marks The student chose an appropriate procedure, but made major errors in applying it (i.e. errors relating to methods, rules, laws, systems or theories).

1 mark The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly.) (e.g. Student found only d_i.)

0 marks The student showed no work 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 answer**



Answer: Magnitude of the force exerted on the fourth rope is 440.2 N.
Direction of the force exerted on the fourth rope is [W37°S] or 217°.

NOTE A mathematical solution is acceptable.

4 marks The student chose an appropriate procedure and applied it correctly; the final answer is correct. (e.g. The scaled diagram is correctly drawn or another procedure is correctly demonstrated); the magnitude and direction is correct within 5 N and 3°.

3 marks The student chose an appropriate procedure, but made minor errors in applying it (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly). (e.g. Resultant is found but not the equilibrant.)

2 marks The student chose an appropriate procedure, but made major errors in applying it (e.g. accuracy of drawing) or minor errors in calculation and transcription.

1 mark The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly.)

0 marks The student showed no work 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 answer**

Time needed to reach max. height

$v_2 = v_1 + a\Delta t$

$0 = -5.00 \text{ m/s} + (9.8 \text{ m/s}^2)\ \Delta t$

$\Delta t = \dfrac{5.00 \text{ m/s}}{9.8 \text{ m/s}^2}$

$\Delta t = 0.510$ seconds to reach max. height

Distance from release to max. height

$\Delta d = \dfrac{(v_2 + v_1)\ \Delta t}{2}$

$\Delta d = \dfrac{(0 \text{ m/s} + 5.00 \text{ m/s})\ 0.510 \text{ s}}{2}$

$\Delta d = 1.28$ m

Distance from max. height to ground

1.28 m + 12.0 m = 13.28 m

Time needed to fall from max. height to ground

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

$13.28 \text{ m} = (0 \text{ m/s})\ t + \dfrac{1}{2}\ (9.8 \text{ m/s}^2)\ \Delta t^2$

$\Delta t^2 = \dfrac{13.28 \text{ m} \times 2}{9.8 \text{ m/s}^2}$

$\Delta t = \sqrt{\dfrac{13.28 \text{ m} \times 2}{9.8 \text{ m/s}^2}}$

$\Delta t = 1.65$ seconds to fall from max. height to ground

Total time to reach max. height and fall to ground is 0.510 s + 1.65 s = 2.16 s

Answer: The time it takes the ball to hit the ground from the instant it is released is **2.16 s**.

Note: A solution using the quadratic equation is acceptable.

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 (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly).

2 marks The student chose an appropriate procedure, but made major errors in applying it (e.g. accuracy of drawing) or minor errors in calculation and transcription. (e.g. Student calculated the time for downward motion only.)

1 mark The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly.)

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

25 **Example of an appropriate and complete answer**

Calculating car's acceleration

$v_2 = v_1 + a\Delta t$

15.0 m/s = 0 m/s + a (10.0 s)

$$a = \frac{15.0 \text{ m/s}}{10.0 \text{ s}}$$

$a = 1.50 \text{ m/s}^2$

Calculating car's net force

$F = ma$
$F = 2.00 \times 10^3 \text{ kg} \times 1.5 \text{ m/s}^2$
$F = 3.00 \times 10^3 \text{ N}$

Calculating car engine's applied force

$F_{net} = F_{applied} + F_{friction}$

$3.00 \times 10^3 \text{ N} = F_{applied} + (-4.00 \times 10^2 \text{ N})$

$F_{applied} = 3.00 \times 10^3 \text{ N} + 4.00 \times 10^2 \text{ N}$

$F_{applied} = 3.40 \times 10^3 \text{ N}$

Answer: The force applied by the car engine is **3.40×10^3 N.**

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 (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly).

2 marks The student chose an appropriate procedure, but made major errors in applying it (e.g. accuracy of drawing) or minor errors in calculation and transcription. (e.g. Student calculated net force but subtracted the frictional force.)

1 mark The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly.) (e.g. Student calculated net force only.)

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

26 **Example of an appropriate and complete answer**

The IMA of the pulley system is 4. (number of supporting ropes)

Calculating AMA

$$\text{AMA} = \frac{F_r}{F_e} = \frac{500.0\ \text{N}}{150.0\ \text{N}} = 3.333$$

Calculating efficiency

$$\text{Efficiency} = \frac{\text{AMA}}{\text{IMA}} \times 100 = \frac{3.333}{4} \times 100 = 83.33\ \%$$

Answer: The mechanical efficiency of the system is **83.33 %**.

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 (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly).
2 marks	The student chose an appropriate procedure, but made major errors in applying it (e.g. accuracy of drawing) or minor errors in calculation and transcription. (e.g. Student used incorrect IMA.)
1 mark	The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly.) (e.g. Student found IMA or AMA only.)
0 marks	The student showed no work or chose an inappropriate procedure; the answer is missing or incorrect, or it is correct purely by chance.

27 **Example of an appropriate and complete answer**

Total mechanical energy at 410 m

$E_T = E_{potential} + E_{kinetic}$

$E_T = mgh + \frac{1}{2} mv^2$

$E_T = (2.5 \text{ kg}) (9.8 \text{ m/s}^2) (410 \text{ m}) + 0$

$E_T = 10045 \text{ J}$

Speed of rocket at 320 m

$E_T = E_{potential} + E_{kinetic}$

$E_T = mgh + \frac{1}{2} mv^2$

$10045 \text{ J} = (2.5 \text{ kg}) (9.8 \text{ m/s}^2) (320 \text{ m}) + \frac{1}{2} (2.5 \text{ kg}) v^2$

$10045 \text{ J} = 7840 \text{ J} + \frac{1}{2} (2.5 \text{ kg}) v^2$

$2205 \text{ J} = \frac{1}{2} (2.5 \text{ kg}) v^2$

$v^2 = \frac{2205 \text{ J} \times 2}{2.5 \text{ kg}}$

$v = \sqrt{\frac{2205 \text{ J} \times 2}{2.5 \text{ kg}}}$

$v = 42 \text{ m/s}$

Answer: The speed of the rocket at 320 m is **42 m/s**.

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 (i.e. calculations or transcription errors, incorrect units of measure, numbers rounded incorrectly).

2 marks The student chose an appropriate procedure, but made major errors in applying it (i.e. errors relating to methods, rules laws, systems or theories). (e.g. Student used wrong distance to calculate speed.)

1 mark The student's procedure was partially appropriate (i.e. it does not lead to the correct answer, but at least one of the steps is relevant and presented correctly); the answer is missing or incorrect. (e.g. Student calculated only total mechanical energy.)

0 marks The student showed no work 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 52

Question Booklet

Secondary 5

September 2002

Youth Sector General Education

INSTRUCTIONS

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

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

3. In Part B, you are to answer 3 of the 4 questions.

4. In Part C, you are to answer 4 of the 5 questions.

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

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

7. 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

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

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

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

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

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

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

$$W = F\ \Delta d$$

$$F_E l_E = F_R l_R$$

$$E_g = mgh$$

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

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

$$F = ma$$

$$F_g = mg$$

$$F = kx$$

PHYSICAL CONSTANTS

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

Part A

Questions 1 to 18
Blacken the letter of your answer on the answer sheet provided.

1 **Which of the following explains why this page is visible?**

A) It is incandescent.

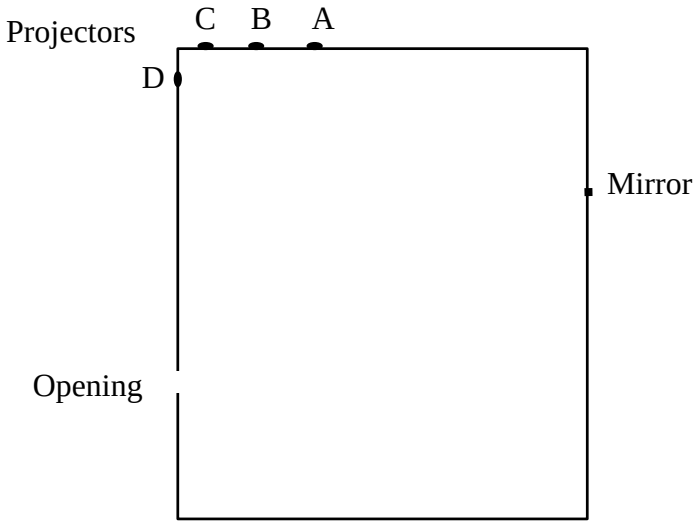
B) It emits light.

C) It refracts light.

D) It reflects light.

2 Four projectors A, B, C and D are located in a room. A light ray originating from one of the projectors is reflected by a small mirror. The reflected ray passes through the opening.

From which projector did the light ray originate?



A) Projector A

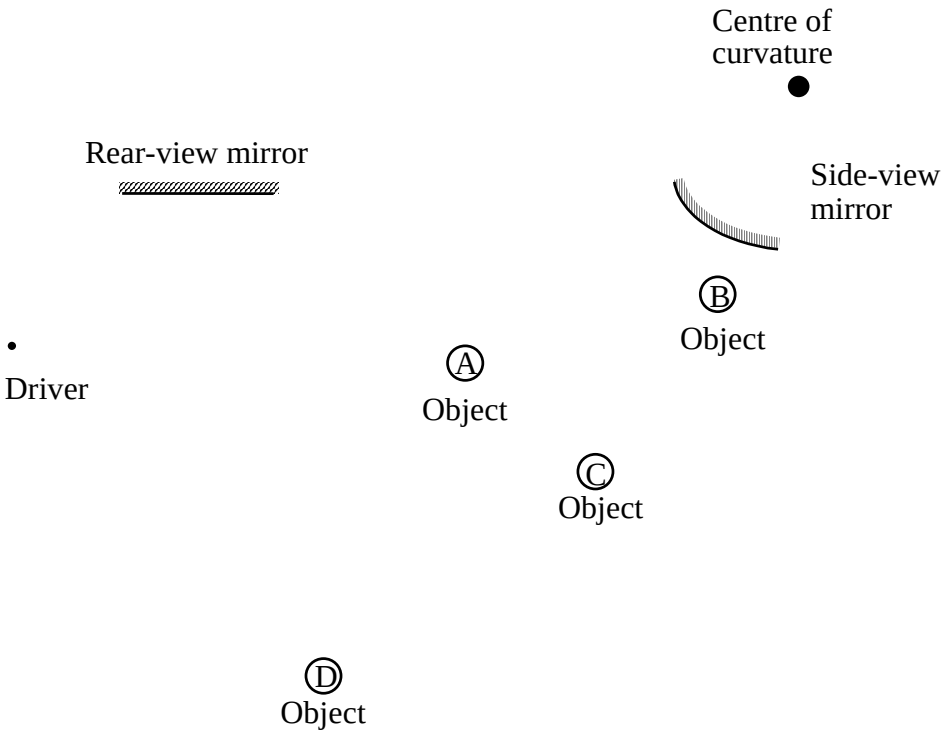
B) Projector B

C) Projector C

D) Projector D

3 A car driver can use either the rear-view mirror (plane mirror) or the passenger-side mirror (convex mirror) to see the objects behind the car.

According to the diagram below, which object can be seen by the driver in both of the mirrors?



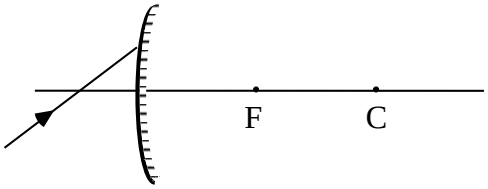
A) Object A

B) Object B

C) Object C

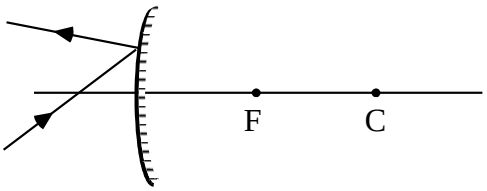
D) Object D

4 The diagram below shows a light ray incident on a convex mirror.

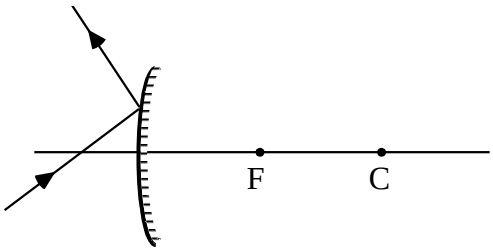


Which of the following diagrams best represents the path of the reflected ray?

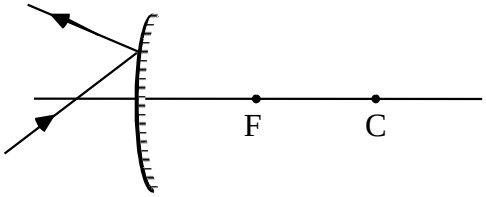
A)



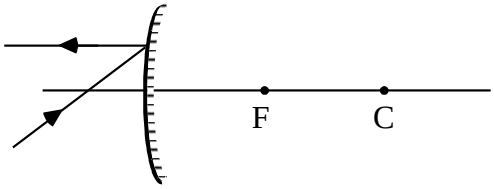
C)



B)



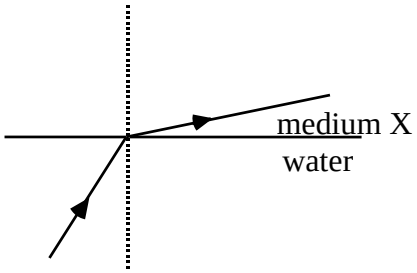
D)



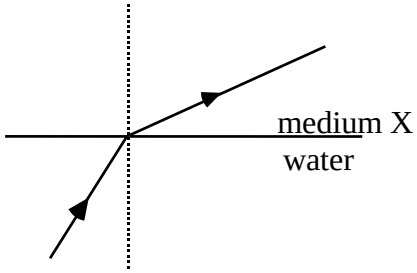
5 The diagrams below represent light travelling from water into medium X.

In which diagram does medium X have the highest index of refraction?

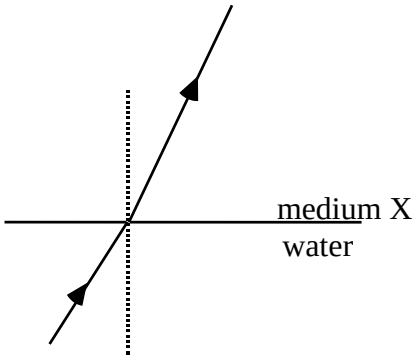
A)



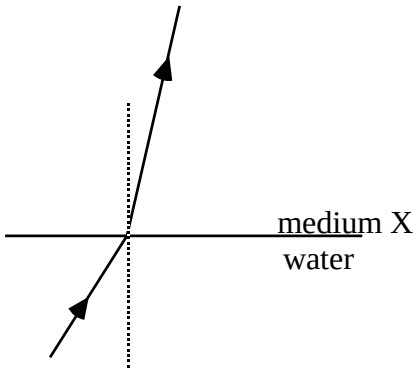
C)



B)

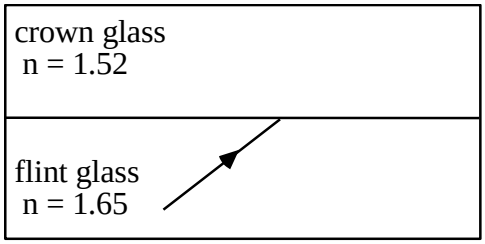


D)



6 Light travels from flint glass (n = 1.65) into crown glass (n = 1.52).

What is the critical angle for flint glass in this situation?



A) 37.3°

B) 41.1°

C) 67.1°

D) 90.0°

7 A student uses a double convex lens with a focal length of 8.0 cm to view an object placed 4.0 cm beyond the focal point. The image formed is 12 cm high.

What will be the characteristics of the image?

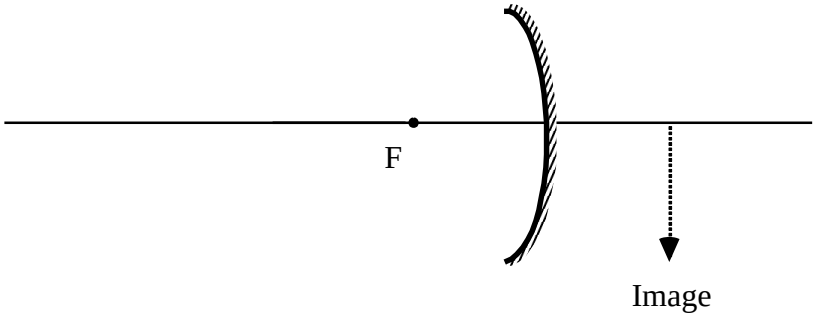
A) Real, inverted and larger

B) Virtual, inverted and larger

C) Real, inverted and smaller

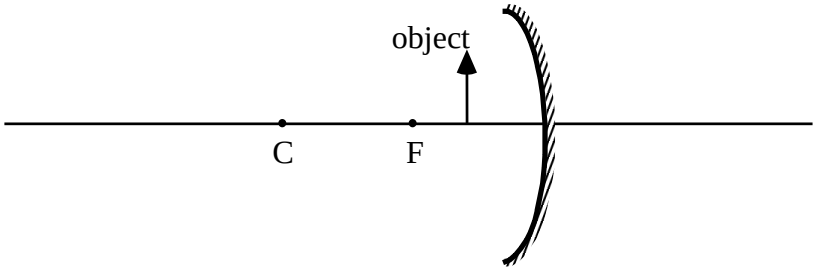
D) Virtual, upright and smaller

8 Given the following situation for a concave mirror.

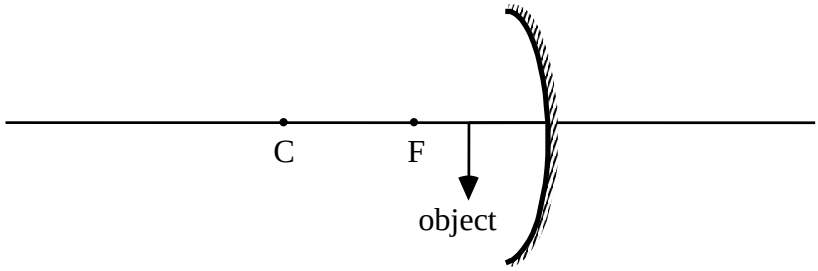


Which of the diagrams below accurately shows the position and size of the object, given its image as seen in the above diagram?

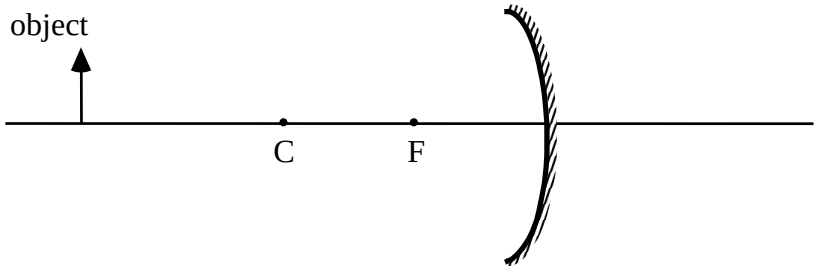
A)



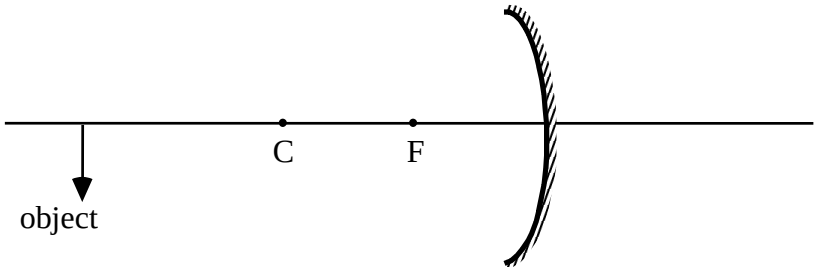
B)



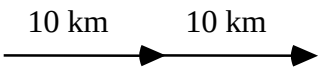
C)

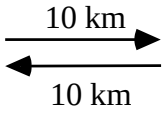


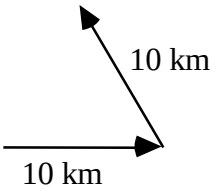
D)

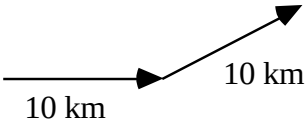


9 **Which of the following situations will produce the displacement with the greatest magnitude?**

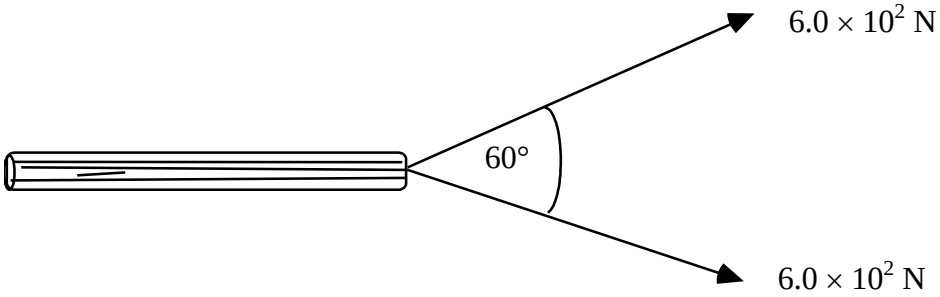
A) 

C) 

B) 

D) 

10 Two horses are pulling a log. The force applied by each horse is shown in the diagram below.



Which of the following is the magnitude of the equilibrant force?
(Neglect friction.)

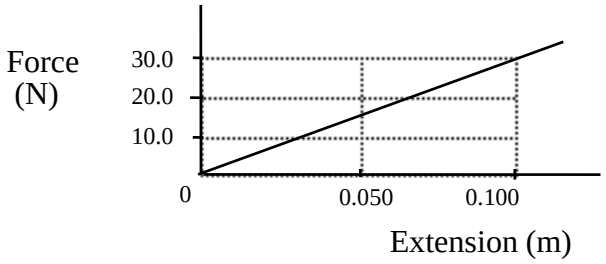
A) 5.2×10^2 N

B) 6.0×10^2 N

C) 1.0×10^3 N

D) 1.2×10^3 N

11 The graph of Force versus Extension for a spring is given below.



A 20.0 kg mass is suspended from the same spring.

Which of the following represents the extension of the spring for this mass?

A) 7.00×10^{-2} m

B) 6.53×10^{-1} m

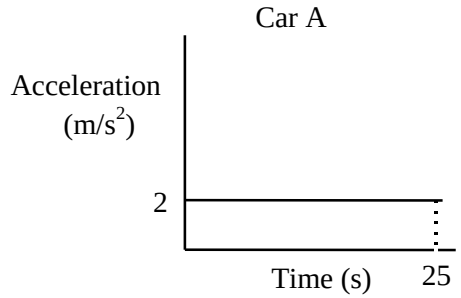
C) 1.53×10^{0} m

D) 3.00×10^{2} m

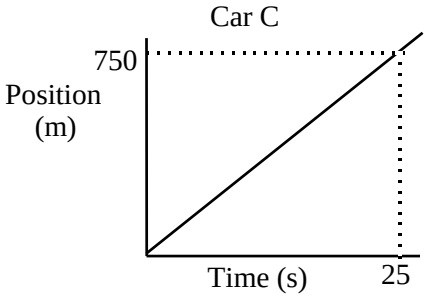
12 The graphs below describe the motions of four different cars starting from rest.

Which car is travelling the fastest at 25 seconds?

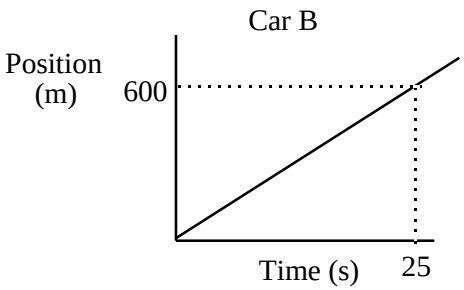
A)



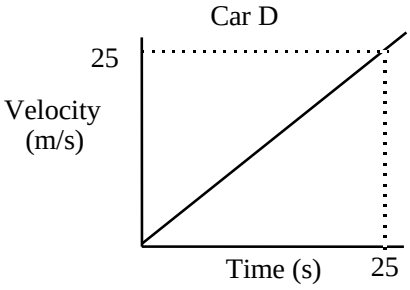
C)



B)

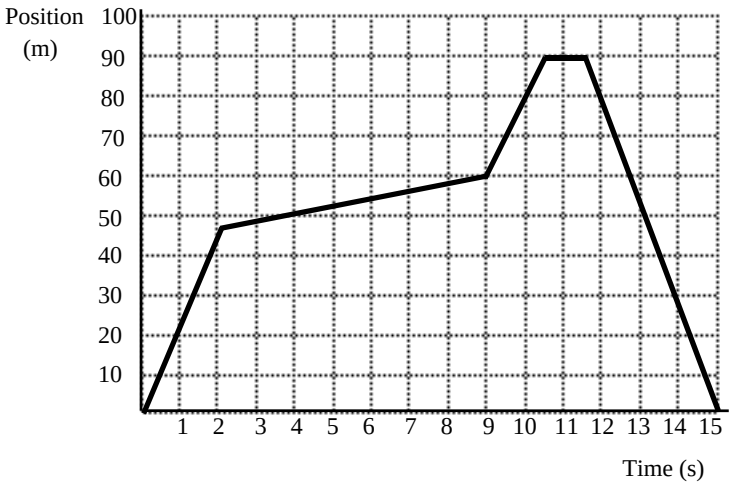


D)



13 The graph below shows the change of position of a cart through a 15 second interval.

What was the average acceleration of the cart from the 3rd to the 10th second?



A) 0.60 m/s^2

B) 2.6 m/s^2

C) 4.3 m/s^2

D) 11 m/s^2

14 **Which of the following units is equivalent to a newton?**

A) kg • m • s^2

B) kg/m/s^2

C) kg /m • s^2

D) kg • m/s^2

15 An object weighing 2.0×10^1 N at Earth's surface is moved to a location where its weight is 1.0×10^1 N.

What is the acceleration due to gravity at this location?

A) 2.0 m/s^2

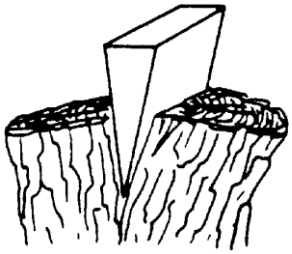
B) 2.4 m/s^2

C) 4.9 m/s^2

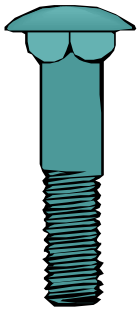
D) 9.8 m/s^2

16 Several machines are shown in the diagram below.

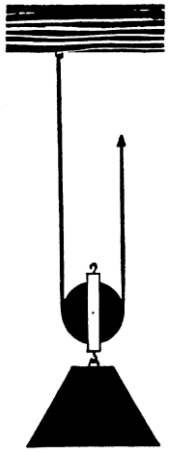
1



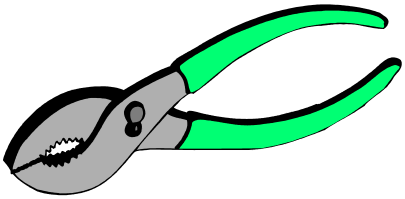
2



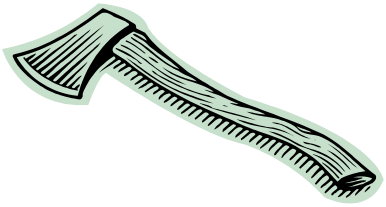
3



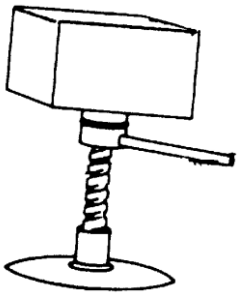
4



5



6



Which machines are variations of the inclined plane?

A) 1, 2, 3 and 5

B) 1, 2, 4 and 6

C) 1, 2, 5 and 6

D) 3, 4, 5 and 6

17 **In which of the following situations is mechanical work being done?**
(Neglect air resistance)

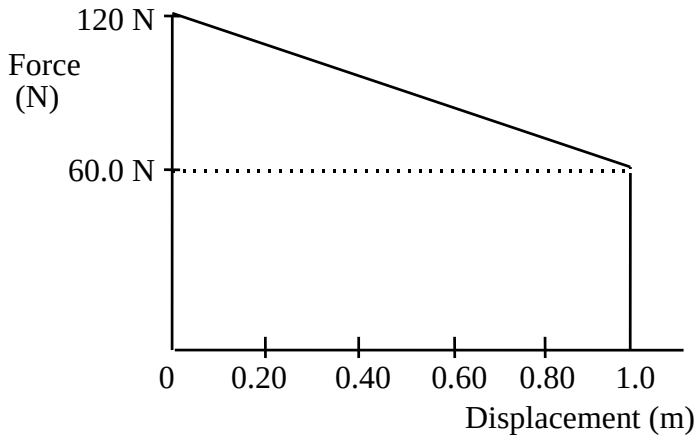
A) The Olympic Stadium roof supports tonnes of ice and snow in the winter.

B) A puck slides along a frictionless surface of a hockey rink.

C) A hockey bag is carried across a locker room.

D) A referee drops a puck to the ice during a face-off.

18 A 5.0 g object is initially at rest at the start of a 1.0 m track. The following graph represents the force applied to it as it travels along the track.



Calculate the speed of the object as it leaves the end of the track.

A) 6.0×10^0 m/s

B) 1.9×10^2 m/s

C) 2.2×10^2 m/s

D) 3.6×10^4 m/s

Parts B and C of the examination comprise questions for which 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. 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; however, significant figures will not be considered.

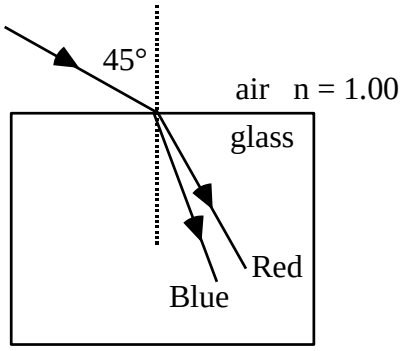
Part B

Questions 19, 20, 21 and 22
Choose any **three** of these questions and answer them in the answer booklet.

19 Stuart uses three lenses to construct an optical device. The first lens has an optical power of -2.00 diopters. The second lens has a focal length of 20.0 cm.

What is the focal length of the third lens if the total optical power of the combination must be 1.50 diopters?

20 The index of refraction for a certain kind of glass is 1.67 for blue light and 1.61 for red light. A beam containing these two colours hits the glass with an angle of incidence of 45°. (Diagram is not drawn to scale.)



Calculate the angle between the two refracted rays.

21 A 15.0 cm high vase is placed 50.0 cm in front of a diverging lens. The focal point is 30.0 cm away from the lens.

Find the height of the image of the vase.

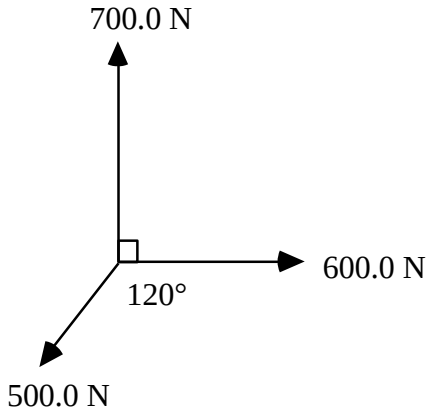
22 A 2.0 cm tall object is located 4.0 cm from a converging lens that has a focal length of 12 cm.

What is the magnification of the image?

Part C

Questions 23, 24, 25, 26 and 27
Choose any **four** of these questions and answer them in the answer booklet.

23 A bull is restrained by four ropes. The diagram below shows three of these ropes and the force that is exerted on each. (Diagram is not drawn to scale.)

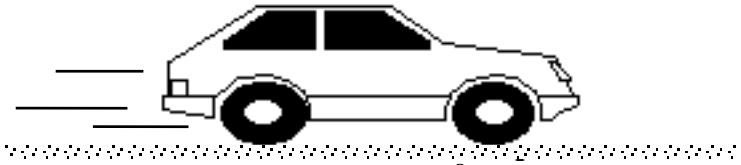


Find the magnitude and direction of the force that must be exerted on the fourth rope in order to restrain the bull completely.

24 A student conducts a free-fall experiment while standing on the edge of the school roof 12.0 m above the ground. The student throws a heavy ball vertically upwards at a velocity of 5.00 m/s. On its way down, the ball narrowly misses the roof and hits the ground.

How long does it take the ball to hit the ground from the instant it is released?

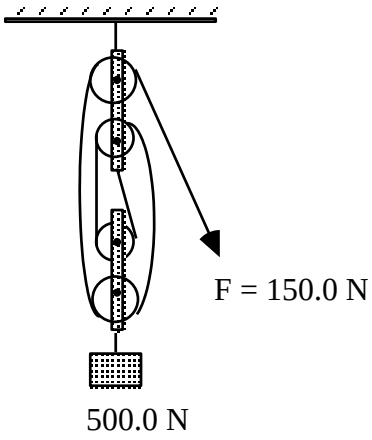
25 A 2.00×10^3 kg car is accelerated uniformly on a straight level highway from rest to a velocity of 15.0 m/s in 10.0 seconds.



mass = 2.00×10^3 kg

If there is road friction of 4.00×10^2 N acting on the tires, what total force must be applied by the car engine?

26 A pulley system is used to raise a 500.0 N weight. A force of 150.0 N is applied to the end of the rope as shown below.



Determine the mechanical efficiency of this system.

27 A model rocket with a mass of 2.5 kg is fired directly upwards and rises to a maximum height of 410 m.

What is the speed of the rocket at 320 m?
(Neglect air resistance.)

GRICS

554-534

Physics

Comprehensive Exam
Number 52

Answer Booklet

Secondary 5

September 2002

Student's Name	
Group	Date

Youth Sector General Education

PART A

Questions 1 to 18
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]

16 [A] [B] [C] [D]

17 [A] [B] [C] [D]

18 [A] [B] [C] [D]

PART B

Questions 19, 20, 21 and 22
Choose any **three** of these questions and answer them in this answer booklet.
If you answer all four questions, **circle the numbers of the three** that you want marked.
If you do not circle the three you want marked, only questions 19, 20 and 21 will be marked.
Each question is worth four marks.

19

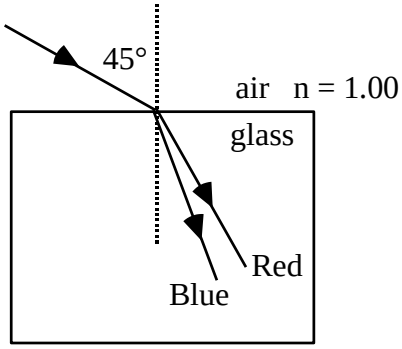
SHOW ALL YOUR WORK

Answer: The focal length of the third lens is _____m.

4	3	2	1	0

20

SHOW ALL YOUR WORK



Answer: The angle between the two refracted rays is _____°.

4	3	2	1	0

21

SHOW ALL YOUR WORK

Answer: The height of the image of the vase is _____cm.

4	3	2	1	0

22

SHOW ALL YOUR WORK

Answer: The magnification of the image is _____.

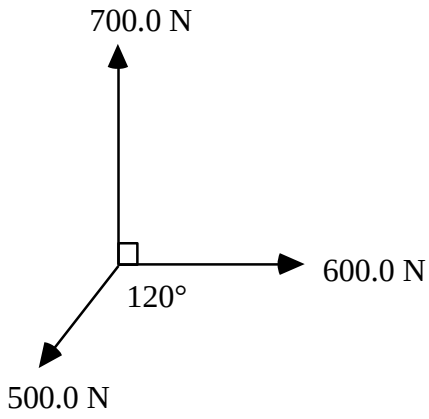
4	3	2	1	0

PART C

Questions 23, 24, 25, 26 and 27
Choose any **four** of these questions and answer them in this answer booklet.
If you answer all five questions, **circle the numbers of the four** that you want marked.
If you do not circle the four you want marked, only questions 23, 24, 25 and 26 will be marked.
Each question is worth four marks.

23

SHOW ALL YOUR WORK



Answer: The magnitude of the force exerted on the fourth rope is _____ N.

The direction of the force exerted on the fourth rope is _____.

4	3	2	1	0

24

SHOW ALL YOUR WORK

Answer: The time it takes the ball to hit the ground from the instant it is released is _____ s.

4	3	2	1	0

25

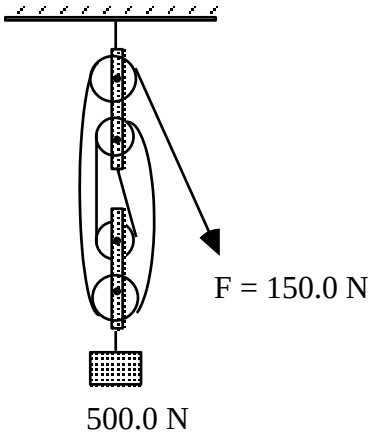
SHOW ALL YOUR WORK

Answer: The force applied by the car engine is _____ N.

4	3	2	1	0

26

SHOW ALL YOUR WORK



Answer: The mechanical efficiency of the system is _____ %.

4	3	2	1	0

27

SHOW ALL YOUR WORK

Answer: The speed of the rocket at 320 m is _____ m/s.

4	3	2	1	0