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Physics 12

JANUARY 2002

Course Code = PH

### Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by **END OF EXAMINATION**.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.



Question 1:

1.  .

(7)

Question 8:

8.  .

(5)

Question 2:

2.  .

(9)

Question 9:

9.  .

(4)

Question 3:

3.  .

(7)

Question 4:

4.  .

(7)

Question 5:

5.  .

(7)

Question 6:

6.  .

(7)

Question 7:

7.  .

(7)



**PHYSICS 12**

**JANUARY 2002**

COURSE CODE = PH

## GENERAL INSTRUCTIONS

1. Aside from an approved calculator, electronic devices, including dictionaries and pagers, are **not** permitted in the examination room.
2. All multiple-choice answers must be entered on the Response Form using an **HB pencil**. Multiple-choice answers entered in this examination booklet will **not** be marked.
3. For each of the written-response questions, write your answer in the space provided in this booklet. Rough-work space has been incorporated into the space allowed for answering each written-response question. You may not need all of the space provided to answer each question.
4. Ensure that you use language and content appropriate to the purpose and audience of this examination. Failure to comply may result in your paper being awarded a zero.
5. This examination is designed to be completed in **two hours**. *Students may, however, take up to 30 minutes of additional time to finish.*

## PHYSICS 12 PROVINCIAL EXAMINATION

- |   | Value         | Suggested Time     |
|---|---------------|--------------------|
| 1. This examination consists of <b>two</b> parts:         |               |                    |
| PART A: 30 multiple-choice questions worth two marks each | 60            | 60                 |
| PART B: 9 written-response questions                      | 60            | 60                 |
|   | <b>Total:</b> | <b>120 marks</b>   |
|   |               | <b>120 minutes</b> |
2. The last **three** pages inside the back cover contain the **Table of Constants, Mathematical Equations, Formulae, and Rough Work for Multiple-Choice**. These pages may be detached for convenient reference prior to writing this examination.
3. **A calculator is essential for the Physics 12 Provincial Examination.** The calculator must be a hand-held device designed primarily for mathematical computations involving logarithmic and trigonometric functions and may also include graphing functions. Computers, calculators with a QWERTY keyboard, and electronic writing pads will not be allowed. Students must not bring any external devices to support calculators such as manuals, printed or electronic cards, printers, memory expansion chips or cards, or external keyboards. Students may have more than one calculator available during the examination. Calculators may not be shared and must not have the ability to either transmit or receive electronic signals. In addition to an approved calculator, students will be allowed to use rulers, compasses, and protractors during the examination.
4. a) Final answers must include appropriate **units**.  
b) Marks will not be deducted for answers expressed to **two** or **three** significant figures.  
c) In this examination the zero in a number such as 30 shall be considered to be a significant zero.
5. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution. Full marks will **not** be awarded for providing **only** a final answer.

If you are unable to determine the value of a quantity required in order to proceed, you may assume a reasonable value and continue toward the solution. Such a solution, however, may not be eligible for full marks.

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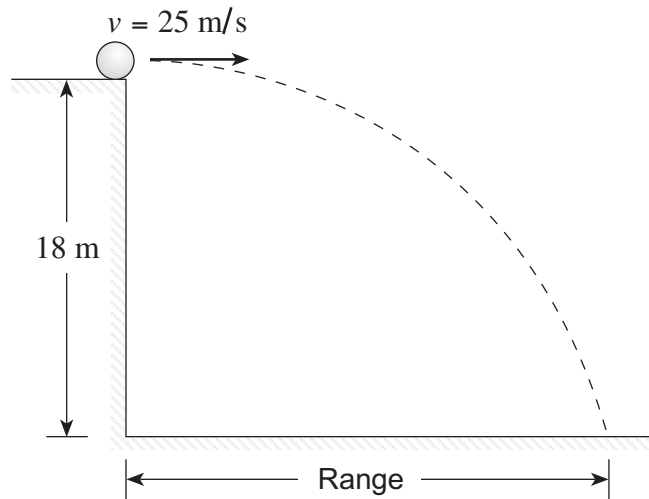
**PART A: MULTIPLE CHOICE**

**Value: 60 marks (2 marks per question)**

**Suggested Time: 60 minutes**

**INSTRUCTIONS:** For each question, select the **best** answer and record your choice on the Response Form provided. Using an HB pencil, completely fill in the circle that has the letter corresponding to your answer.

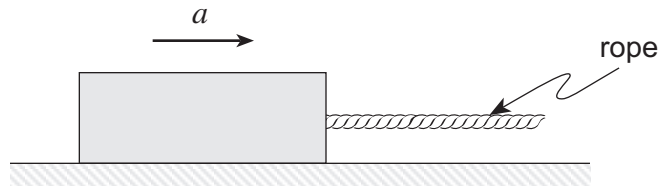
1. Which of the following contains only scalar quantities?
  - A. mass, speed
  - B. mass, velocity
  - C. displacement, speed
  - D. displacement, velocity
  
2. An airplane heads due north with an airspeed of 75 m/s. The wind is blowing due west at 18 m/s. What is the airplane's speed relative to the ground?
  - A. 57 m/s
  - B. 73 m/s
  - C. 77 m/s
  - D. 93 m/s
  
3. What is the range of the projectile launched horizontally at 25 m/s from the 18 m-high cliff edge as shown in the diagram below?



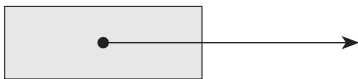
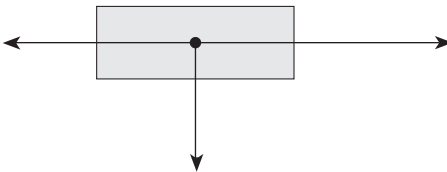
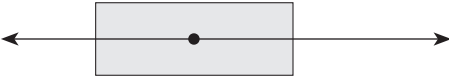
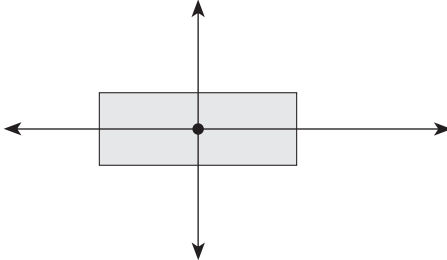
- A. 18 m
- B. 30 m
- C. 46 m
- D. 48 m

**OVER**

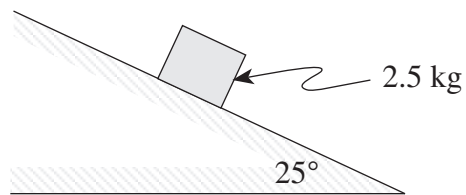
4. The block in the diagram below is being accelerated to the right across a rough surface by a force applied through the rope.



Which of the following best represents a free-body diagram for the block?

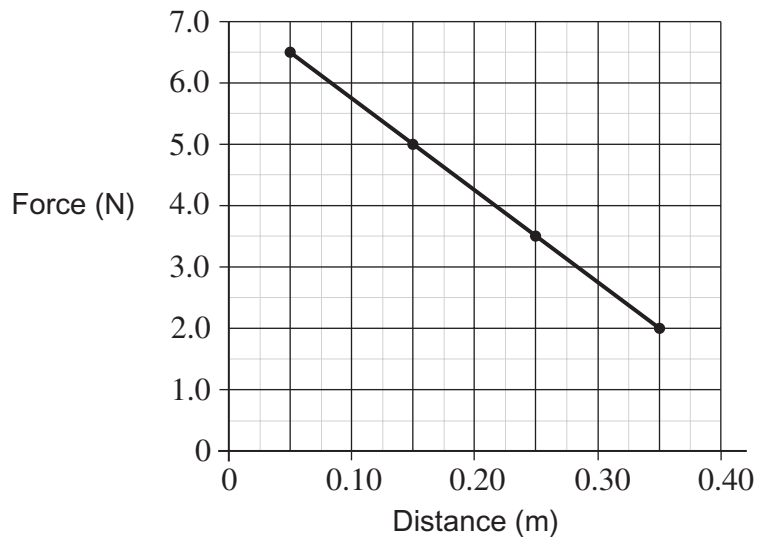
- A.  B. 
- C.  D. 

5. What is the normal force on the block in the diagram below?



- A. 0.0 N  
B. 10 N  
C. 22 N  
D. 25 N

6. A student records the force used to move a block. The graph of his force and distance data is shown below.



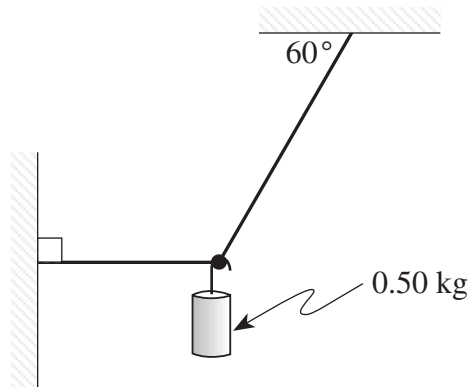
What is the work done in moving the block from 0.050 m to 0.35 m?

- A. 0.68 J
  - B. 0.98 J
  - C. 1.3 J
  - D. 2.0 J
7. Which are correct units for change in momentum?
- A.  $\text{N} \cdot \text{m}$
  - B.  $\text{N} \cdot \text{s}$
  - C.  $\text{kg} \cdot \frac{\text{s}}{\text{m}}$
  - D.  $\text{kg} \cdot \frac{\text{m}}{\text{s}^2}$

8. A 2.3 kg object moving due north at 17 m/s made contact with a barrier for 0.75 s, resulting in a final velocity of 12 m/s due east. What was the impulse on the object?

	MAGNITUDE OF IMPULSE	DIRECTION OF IMPULSE
A.	12 N·s	35° E of N
B.	12 N·s	35° E of S
C.	48 N·s	35° E of N
D.	48 N·s	35° E of S

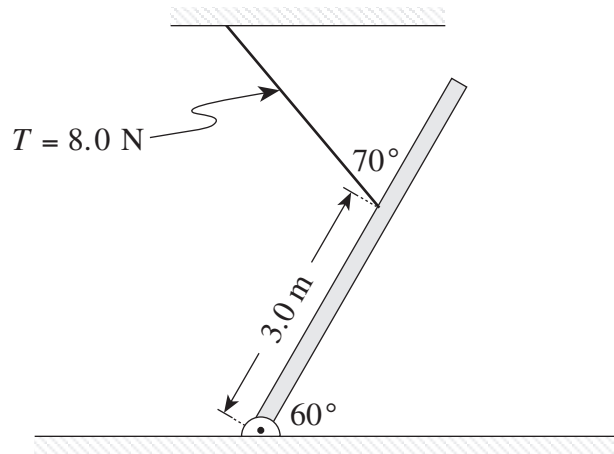
9. A 0.50 kg mass is suspended as shown in the diagram.



What is the tension in the horizontal string?

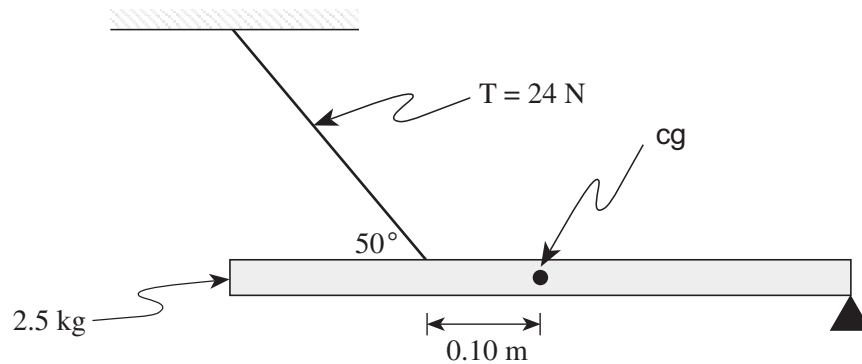
- A. 2.5 N
- B. 2.8 N
- C. 4.2 N
- D. 4.9 N

10. A 5.0 m-long uniform beam is held in position by a cord as shown in the diagram.



If the tension in the cord is 8.0 N, what is the weight of the beam?

- A. 4.8 N
  - B. 8.0 N
  - C. 9.6 N
  - D. 18 N
11. A uniform 2.5 kg beam, pivoted at its right end, is held in a horizontal position by a cable as shown in the diagram.



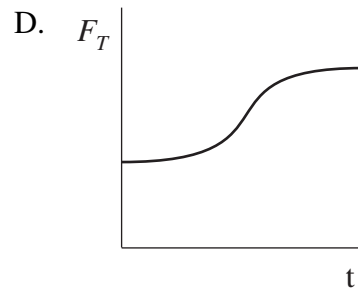
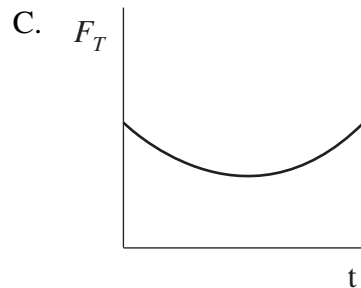
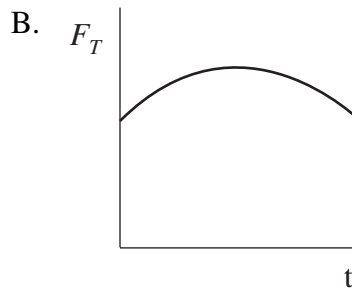
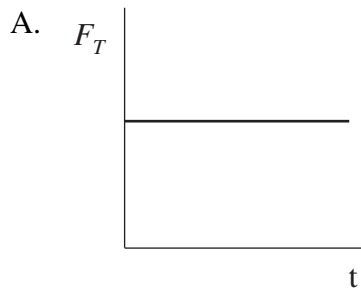
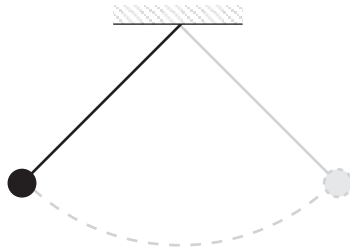
If the cable is attached 0.10 m to the left of the beam's centre of gravity, how long is the beam?

- A. 0.34 m
- B. 0.60 m
- C. 1.2 m
- D. 9.6 m

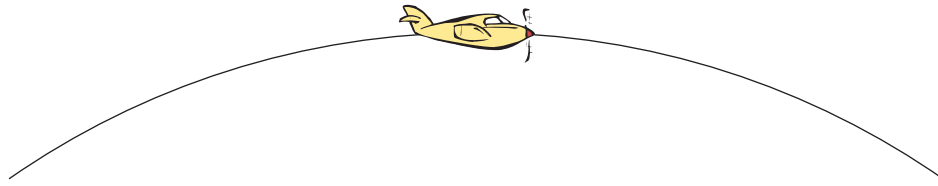
12. Which of the following best describes uniform circular motion?

	SPEED	VELOCITY	ACCELERATION
A.	constant	constant	constant
B.	constant	constant	changing
C.	constant	changing	changing
D.	changing	changing	changing

13. As a simple pendulum swings from one side to the other, the tension in the supporting thread is best represented by which graph?

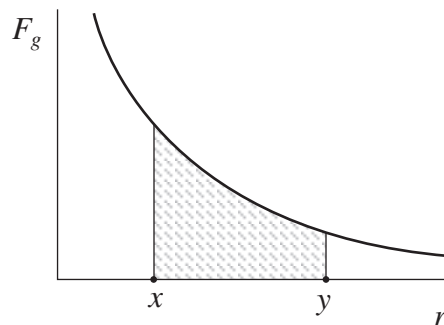


14. An aircraft flies in a vertical circular path of radius 2000 m. At the top of this path the 71 kg pilot feels lighter and experiences a 200 N upward force from the seat.



What is the speed of the aircraft?

- A. 75 m/s  
B. 120 m/s  
C. 140 m/s  
D. 160 m/s
15. As an object moves from  $x$  to  $y$ , the shaded area below the graph of gravitational force versus distance of separation represents

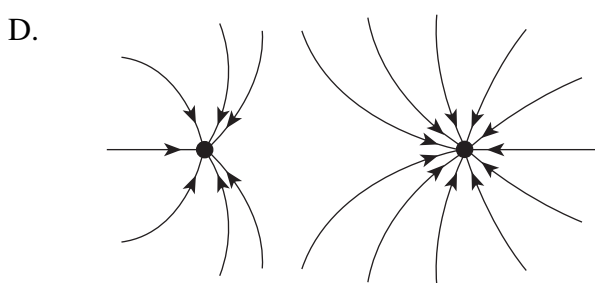
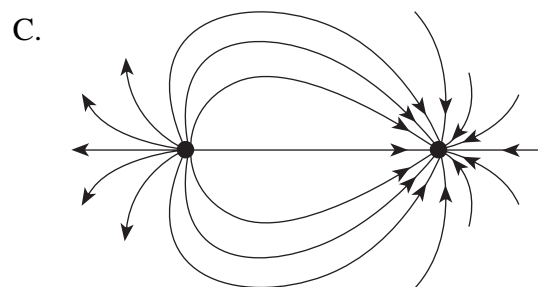
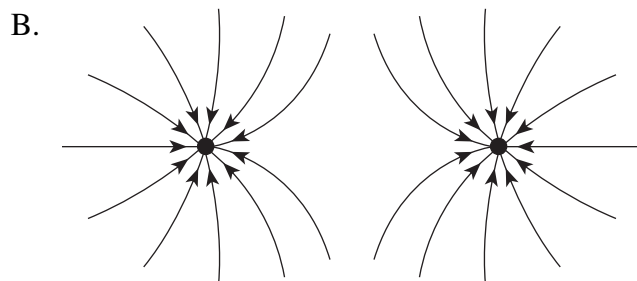
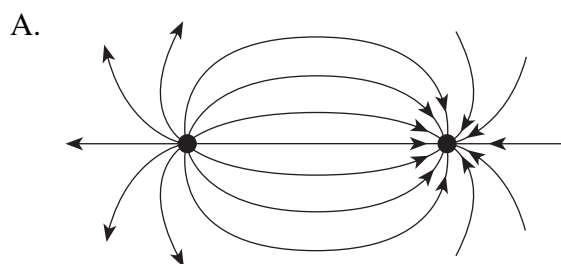


- A. the gain in kinetic energy.  
B. the energy released into space.  
C. the work required to move the object.  
D. the average force required to move the object.
16. A 75 kg astronaut stands on the surface of a planetoid with a mass of  $5.8 \times 10^{21}$  kg and a radius of  $7.3 \times 10^5$  m. What is the gravitational field strength at the surface?
- A. 0.73 N/kg  
B. 1.6 N/kg  
C. 9.8 N/kg  
D. 54 N/kg

17. What minimum energy is required to raise a  $1.7 \times 10^3$  kg vehicle from the surface of the Moon to a height of  $5.22 \times 10^6$  m?

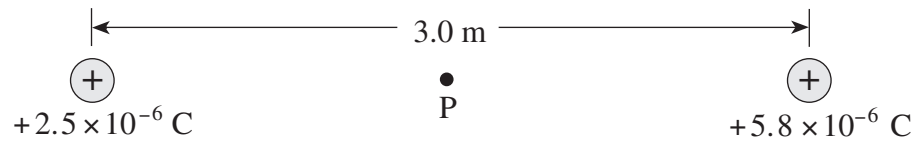
- A.  $1.6 \times 10^9$  J
- B.  $3.6 \times 10^9$  J
- C.  $4.8 \times 10^9$  J
- D.  $1.4 \times 10^{10}$  J

18. Which of the following shows the electric field for two opposite unequal point charges?





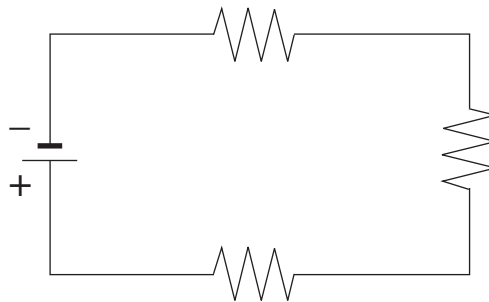
19. Two positive point charges are placed 3.0 m apart as shown.



What is the magnitude of the electric field at point P midway between the two charges?

- A. 0 N/C
- B. 3 300 N/C
- C. 13 000 N/C
- D. 33 000 N/C

20. Examine the electric circuit below.

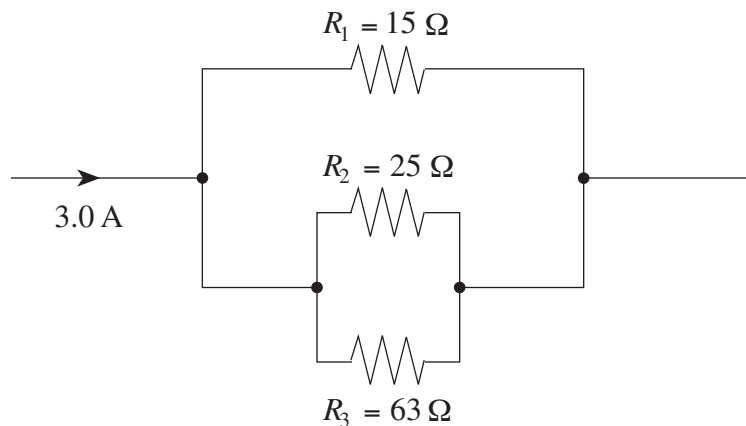


What is the direction of conventional current and electron flow in this circuit?

	CONVENTIONAL CURRENT	ELECTRON FLOW
A.	clockwise	clockwise
B.	clockwise	counter-clockwise
C.	counter-clockwise	clockwise
D.	counter-clockwise	counter-clockwise

21. A potential difference of 12 V causes 0.35 C of electric charge to pass through a resistor in 2.6 s. What power does the resistor dissipate?
- A. 1.6 W
  - B. 4.2 W
  - C. 11 W
  - D. 89 W

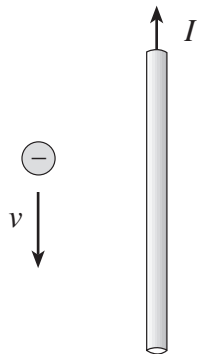
22. The diagram below shows part of an electric circuit.



What is the current through resistor  $R_1$ ?

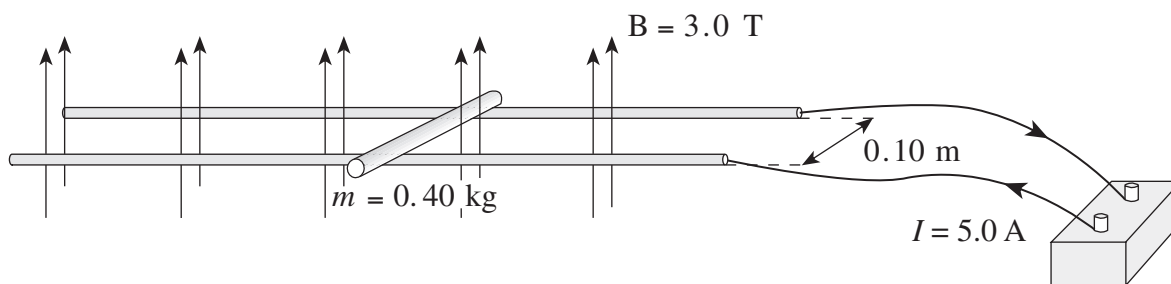
- A. 1.0 A
  - B. 1.4 A
  - C. 1.6 A
  - D. 3.0 A
23. The direction of the magnetic field is the direction of force on a
- A. north magnetic pole.
  - B. south magnetic pole.
  - C. positively charged particle.
  - D. negatively charged particle.

24. What is the direction of the magnetic force on an electron moving near a current-carrying wire as shown?



- A. left
- B. right
- C. into the page
- D. out of the page

25. A 0.40 kg metal slider is sitting on smooth conducting rails as shown below.

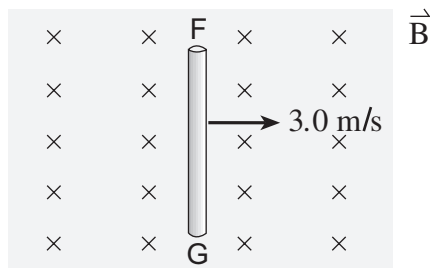


What is the magnitude and direction of the acceleration of the slider? (Ignore friction.)

	MAGNITUDE	DIRECTION
A.	$0.42 \text{ m/s}^2$	left
B.	$0.42 \text{ m/s}^2$	right
C.	$3.8 \text{ m/s}^2$	left
D.	$3.8 \text{ m/s}^2$	right

26. A 0.20 m long solenoid has 750 turns of copper wire and the magnetic field near its centre is measured to be  $3.0 \times 10^{-2}$  T. What is the current flowing through the solenoid?
- A. 1.6 A  
 B. 6.4 A  
 C. 32 A  
 D. 160 A

27. A 0.050 m long conducting wire is moved through a 1.5 T magnetic field as shown below.



What is the magnitude of the emf generated between its ends, and in what direction do the electrons in the conductor initially move?

	EMF (V)	DIRECTION OF ELECTRON MOVEMENT
A.	0.23 V	towards F
B.	0.23 V	towards G
C.	4.5 V	towards F
D.	4.5 V	towards G

28. The circular loop of wire shown below has an area of  $0.40 \text{ m}^2$  and is in a  $0.60 \text{ T}$  magnetic field. This field is increased to  $1.40 \text{ T}$  in  $0.25 \text{ s}$ .

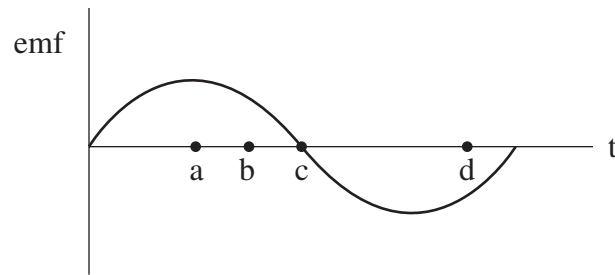


Determine the emf produced in the loop and the direction of current.

	EMF (V)	DIRECTION OF CURRENT
A.	1.3 V	clockwise
B.	1.3 V	counter-clockwise
C.	3.2 V	clockwise
D.	3.2 V	counter-clockwise

29. The load on an electric motor is gradually increased. Which one of the following quantities decreases? (Input voltage remains constant.)
- current
  - back emf
  - armature resistance
  - heat produced by armature

30. The graph below shows how the emf produced by an ac generator varies with time. At which point in time is the rate of flux change in the generator the greatest?



- A. a
- B. b
- C. c
- D. d

**This is the end of the multiple-choice section.  
Answer the remaining questions directly in this examination booklet.**

## PART B: WRITTEN RESPONSE

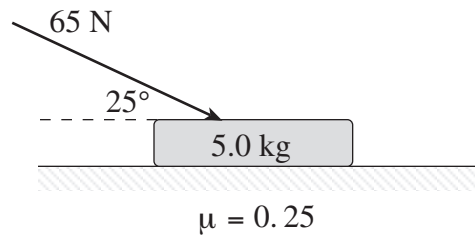
Value: 60 marks

Suggested Time: 60 minutes

### INSTRUCTIONS:

1. Rough-work space has been incorporated into the space allowed for answering each written-response question. You may not need all of the space provided to answer each question.
2.
  - a) Final answers must include appropriate **units**.
  - b) Marks will not be deducted for answers expressed to **two or three** significant figures.
  - c) In this examination the zero in a number such as 30 shall be considered to be a significant zero.
3. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution.
4. If you are unable to determine the value of a quantity required in order to proceed, you may assume a reasonable value and continue toward the solution. Such a solution, however, may not be eligible for full marks.
5. **Full marks will NOT be awarded for providing only a final answer.**

1. A 65 N force is applied to a 5.0 kg object as shown.



The coefficient of friction between the object and the horizontal surface is 0.25.

- a) Draw and label a free body diagram showing the forces acting on the object. **(2 marks)**



b) What is the acceleration of the object?

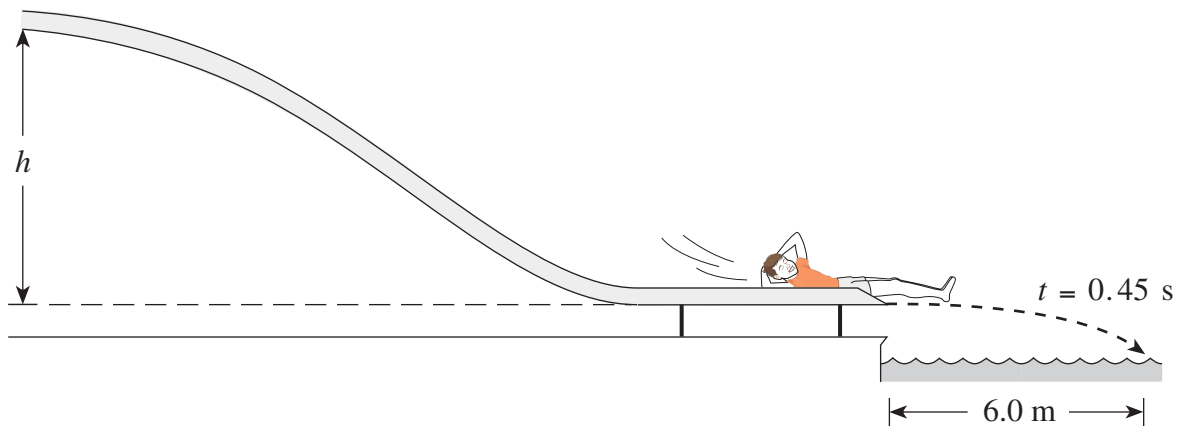
**(5 marks)**

ANSWER:

b) acceleration: \_\_\_\_\_

**OVER**

2. A water slide is made so that swimmers, starting from rest at the top, leave the end of the slide travelling horizontally as shown.



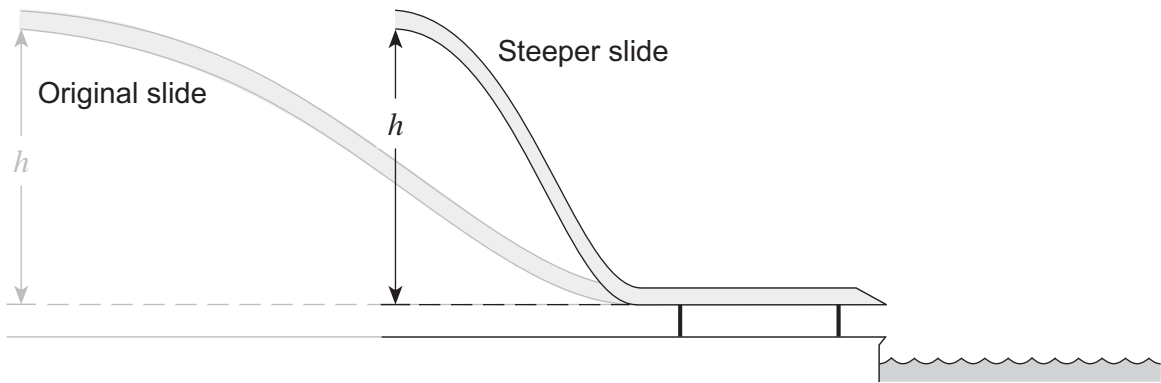
One person is observed to hit the water at a horizontal distance of 6.0 m from the end of the slide 0.45 s after leaving the slide. The effects of friction and air resistance are negligible.

- a) From what vertical height,  $h$ , did the person start? **(5 marks)**

ANSWER:

a) height: \_\_\_\_\_

- b) Another slide has the same vertical height,  $h$ , as the original slide, but has a much steeper slide angle.



The same person is observed to go down this steep slide. Using principles of physics, explain how the new horizontal distance from the edge of the slide compares with the first situation. The effects of friction and air resistance are negligible. **(4 marks)**

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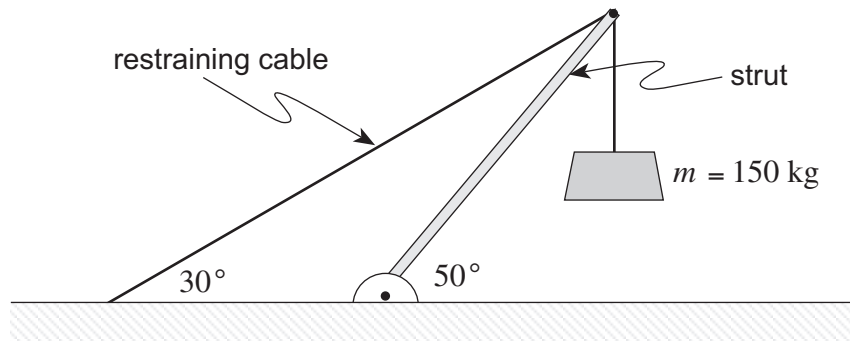
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3. The crane shown in the diagram below is made up of a strut and a restraining cable. The strut is uniform in cross section with a length of 6.0 m and a mass of 85 kg.



What is the tension in the restraining cable while the crane is supporting a 150 kg load?

**(7 marks)**

ANSWER:

tension: \_\_\_\_\_

**OVER**

4. What minimum energy is required to take a stationary  $3.5 \times 10^3$  kg satellite from the surface of the Earth and put it into a circular orbit with a radius of  $6.88 \times 10^6$  m and an orbital speed of  $7.61 \times 10^3$  m/s? (Ignore Earth's rotation.) **(7 marks)**

ANSWER:

minimum energy: \_\_\_\_\_

**OVER**

5. A 12 V battery from a car is used to operate a 65 W headlight.

a) How much energy does the headlight use in 1.5 hours?

**(2 marks)**

ANSWER:

a) energy: \_\_\_\_\_

b) What total charge passes through the headlight during this time?

**(3 marks)**

ANSWER:

b) total charge: \_\_\_\_\_



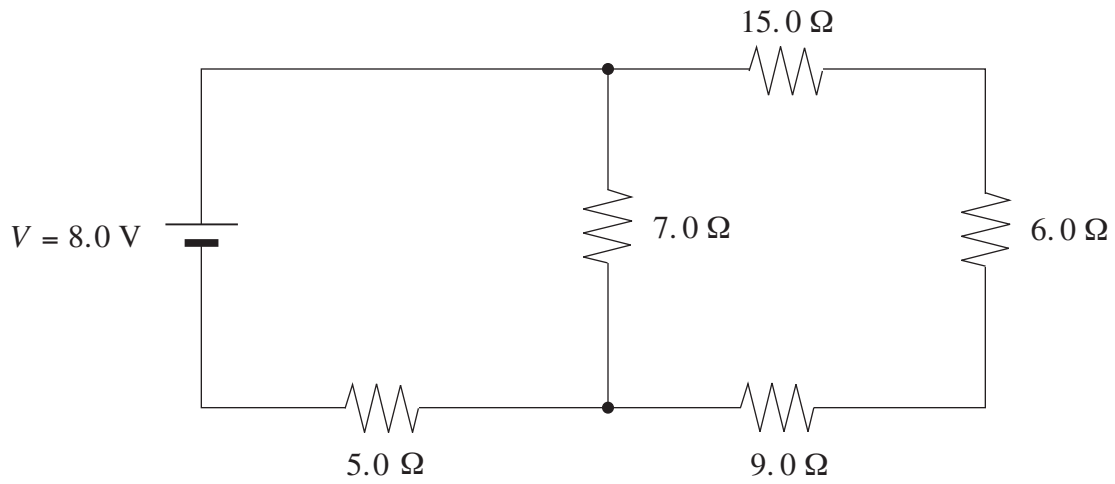
- c) What is the total number of electrons that pass through the headlight during this time period? **(2 marks)**

ANSWER:

c) total number: \_\_\_\_\_

**OVER**

6. What is the potential difference across the  $6.0 \Omega$  resistor in the circuit shown? (7 marks)



ANSWER:

potential difference: \_\_\_\_\_

**OVER**

7. A proton travelling at 2200 m/s enters a 0.15 T magnetic field perpendicularly.

a) What is the magnitude of the proton's acceleration while travelling through the magnetic field?

**(4 marks)**

ANSWER:

a) magnitude of acceleration: \_\_\_\_\_

- b) What is the radius of the proton's circular path while travelling through the magnetic field?  
(3 marks)

ANSWER:

b) radius of proton's path: \_\_\_\_\_

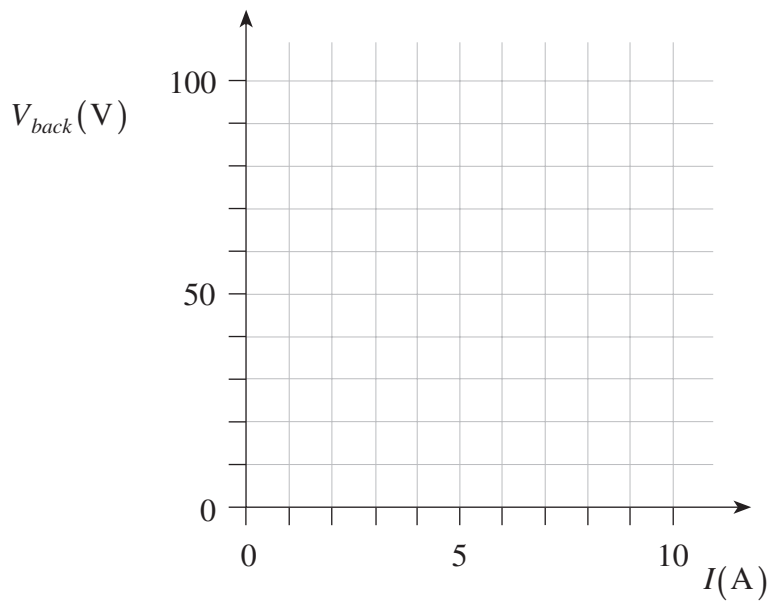
**OVER**

8. A constant voltage is applied to an electric motor being used to lift a series of masses onto a truck. The current through the motor and its back emf are recorded for each different load. This data is shown below.

$I(\text{A})$	$V_{back}(\text{V})$
1.5	98
3.5	84
5.0	76
6.0	70
8.0	54

- a) Plot the data on the graph below and draw the best fit straight line.

**(2 marks)**



b) Determine the magnitude of the slope of the line.

**(1 mark)**

ANSWER:

b) magnitude of the slope: \_\_\_\_\_

c) What does the magnitude of the slope of this line represent?

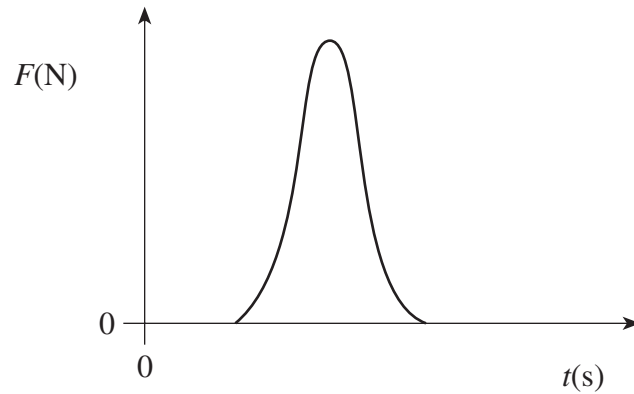
**(2 marks)**

ANSWER:

c) magnitude of the slope represents:

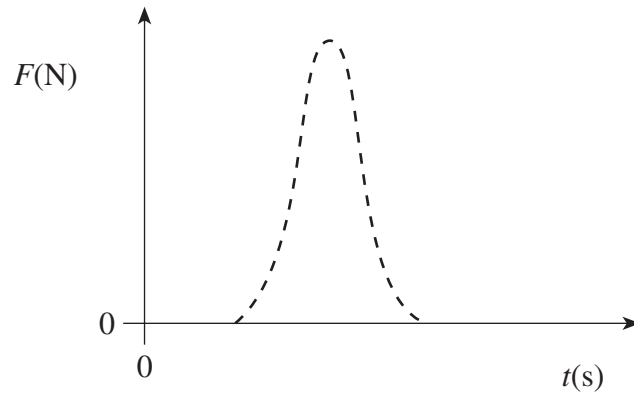
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9. In sports such as golf, tennis and baseball, a player exerts a force over a time interval on a ball, as shown on the graph, in order to give it a high speed.



Players are instructed to “follow through” on their swing. A weaker player may not exert as large a force but may give the ball a higher speed than a stronger player.

- a) Sketch on the graph below how a weaker player can overcome the force handicap. **(1 mark)**



- b) Explain how the player can impart a greater impulse on a ball. **(3 marks)**

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**END OF EXAMINATION**



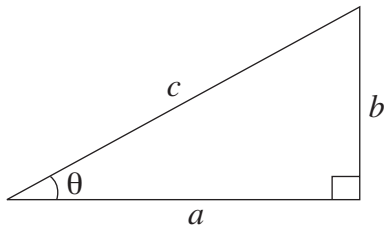
## TABLE OF CONSTANTS

Gravitational constant .....	$G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$
Acceleration due to gravity at the surface of Earth (for the purposes of this examination) .....	$g = 9.80 \text{ m/s}^2$
<b>Earth</b>	
radius .....	$= 6.38 \times 10^6 \text{ m}$
radius of orbit about Sun .....	$= 1.50 \times 10^{11} \text{ m}$
period of rotation .....	$= 8.61 \times 10^4 \text{ s}$
period of revolution about Sun .....	$= 3.16 \times 10^7 \text{ s}$
mass .....	$= 5.98 \times 10^{24} \text{ kg}$
<b>Moon</b>	
radius .....	$= 1.74 \times 10^6 \text{ m}$
radius of orbit about Earth .....	$= 3.84 \times 10^8 \text{ m}$
period of rotation .....	$= 2.36 \times 10^6 \text{ s}$
period of revolution about Earth .....	$= 2.36 \times 10^6 \text{ s}$
mass .....	$= 7.35 \times 10^{22} \text{ kg}$
<b>Sun</b>	
mass .....	$= 1.98 \times 10^{30} \text{ kg}$
Constant in Coulomb's Law .....	$k = 9.00 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$
Elementary charge .....	$e = 1.60 \times 10^{-19} \text{ C}$
Mass of electron .....	$m_e = 9.11 \times 10^{-31} \text{ kg}$
Mass of proton .....	$m_p = 1.67 \times 10^{-27} \text{ kg}$
Mass of neutron .....	$m_n = 1.68 \times 10^{-27} \text{ kg}$
Permeability of free space .....	$\mu_o = 4\pi \times 10^{-7} \text{ T} \cdot \text{m/A}$
Speed of light .....	$c = 3.00 \times 10^8 \text{ m/s}$

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## MATHEMATICAL EQUATIONS

### For Right-angled Triangles:

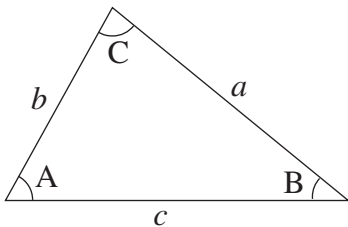


$$a^2 + b^2 = c^2$$

$$\sin \theta = \frac{b}{c} \quad \cos \theta = \frac{a}{c} \quad \tan \theta = \frac{b}{a}$$

$$\text{area} = \frac{1}{2} ab$$

### For All Triangles:



$$\text{area} = \frac{1}{2} \text{base} \times \text{height}$$

$$\sin 2A = 2 \sin A \cos A$$

$$\text{Sine Law: } \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

$$\text{Cosine Law: } c^2 = a^2 + b^2 - 2ab \cos C$$

### Circle:

$$\text{Circumference} = 2\pi r$$

$$\text{Area} = \pi r^2$$

### Sphere:

$$\text{Surface area} = 4\pi r^2$$

$$\text{Volume} = \frac{4}{3} \pi r^3$$

### Quadratic Equation:

$$\text{If } ax^2 + bx + c = 0, \text{ then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

**Vector Kinematics in Two Dimensions:**

$$v = v_0 + at \qquad \bar{v} = \frac{v + v_0}{2}$$

$$v^2 = v_0^2 + 2ad \qquad d = v_0t + \frac{1}{2}at^2$$

**Vector Dynamics:**

$$F_{\text{net}} = ma \qquad F_g = mg$$

$$F_{\text{fr}} = \mu F_N$$

**Work, Energy, and Power:**

$$W = Fd \qquad E_p = mgh$$

$$E_k = \frac{1}{2}mv^2 \qquad P = \frac{W}{t}$$

**Momentum:**

$$p = mv \qquad \Delta p = F\Delta t$$

**Equilibrium:**

$$\tau = Fd$$

**Circular Motion:**

$$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

**Gravitation:**

$$F = G \frac{m_1 m_2}{r^2} \qquad E_p = -G \frac{m_1 m_2}{r}$$

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### Electrostatics:

$$F = k \frac{Q_1 Q_2}{r^2} \quad E = \frac{F}{Q}$$

$$\Delta V = \frac{\Delta E_p}{Q} \quad E = \frac{\Delta V}{d}$$

$$E_p = k \frac{Q_1 Q_2}{r} \quad V = \frac{kQ}{r}$$

### Electric Circuits:

$$I = \frac{Q}{t} \quad V = IR$$

$$V_{\text{terminal}} = \mathcal{E} \pm Ir \quad P = IV$$

### Electromagnetism:

$$F = BIl \quad F = QvB$$

$$B = \mu_0 n I = \mu_0 \frac{N}{l} I \quad \mathcal{E} = Blv$$

$$\Phi = BA \quad \mathcal{E} = -N \frac{\Delta \Phi}{\Delta t}$$

$$V_{\text{back}} = \mathcal{E} - Ir$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$$

**ROUGH WORK FOR MULTIPLE-CHOICE**

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## ROUGH WORK FOR MULTIPLE-CHOICE



