INSERT STUDENT I.D. NUMBER (PEN)

STICKER IN THIS SPACE

JANUARY 1999

PROVINCIAL EXAMINATION

MINISTRY OF EDUCATION

PHYSICS 12

GENERAL INSTRUCTIONS

1. Insert the stickers with your Student I.D. Number (PEN) in the allotted spaces above and on the **back** cover of this booklet. **Under no circumstance is your name or identification, other than your Student I.D. 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. 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.

5. For each of the written-response questions, write your answer in the space provided in this booklet.

6. 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.

7. 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.

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PHYSICS 12 PROVINCIAL EXAMINATION

1. This examination consists of **two** parts:

		Value	Suggested Time
PART A:	30 multiple-choice questions worth two marks each	60	60
PART B:	9 written-response questions	60	60
	Total:	**120 marks**	**120 minutes**

2. Aside from an approved calculator, electronic devices, including dictionaries and pagers, are **not** permitted in the examination room.

3. 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.

4. 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.

5. **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.

6. 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.

7. 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.

8. The time allotted for this examination is **two hours**.

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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.

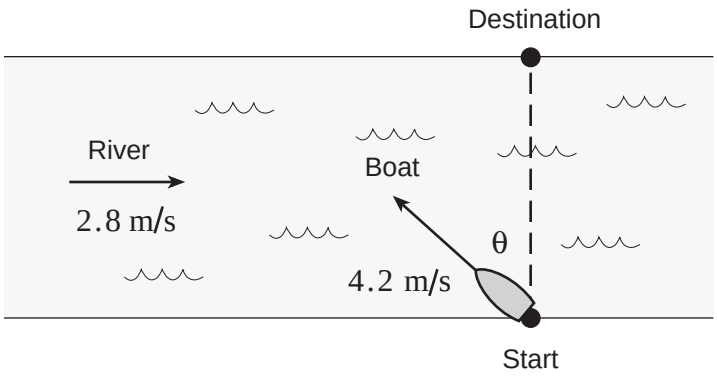
1. Which of the following is a vector quantity?

   A. work
   B. electric field
   C. kinetic energy
   D. potential energy

2. An object is launched over level ground at $35°$ above the horizontal with an initial speed of $52\ \text{m/s}$. What is the time of flight?

   A. $5.3\ \text{s}$
   B. $6.1\ \text{s}$
   C. $8.7\ \text{s}$
   D. $11\ \text{s}$

3. A boat shown below travels at $4.2\ \text{m/s}$ relative to the water, in a river flowing at $2.8\ \text{m/s}$.

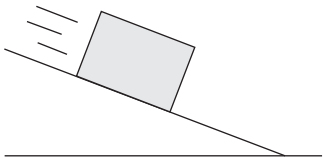


   At what angle θ must the boat head to reach the destination directly across the river?

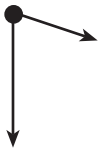
   A. $34°$
   B. $42°$
   C. $48°$
   D. $56°$

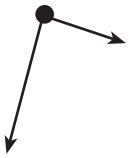
OVER

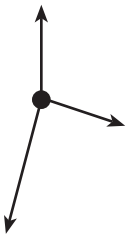
4. A block is on a frictionless incline.



Which of the following is a correct free body diagram for the block?

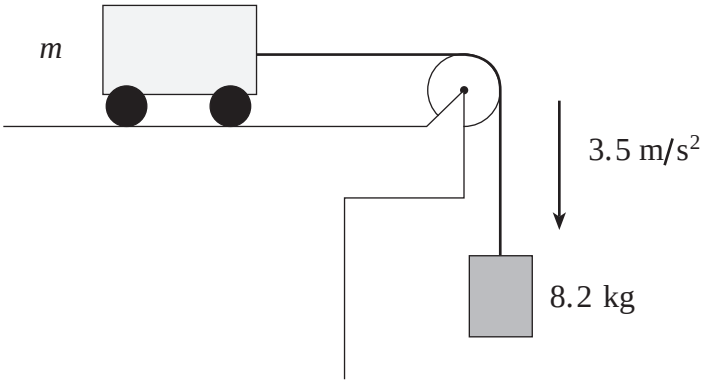
A. 

B. 

C. 

D. 

5. A cart on a frictionless surface is attached to a hanging mass of 8.2 kg.



If this system accelerates at 3.5 m/s^2, what is the mass m of the cart?

A. 6.0 kg
B. 15 kg
C. 23 kg
D. 31 kg

6. A cyclist increases his kinetic energy from 1100 J to 5200 J in 12 s. His power output during this time is

A. 92 W
B. 260 W
C. 340 W
D. 430 W

7. Which of the following best represents the momentum of a small car travelling at a city speed limit?

   A. $1\,000\ \text{kg} \cdot \text{m/s}$
   B. $10\,000\ \text{kg} \cdot \text{m/s}$
   C. $100\,000\ \text{kg} \cdot \text{m/s}$
   D. $1\,000\,000\ \text{kg} \cdot \text{m/s}$

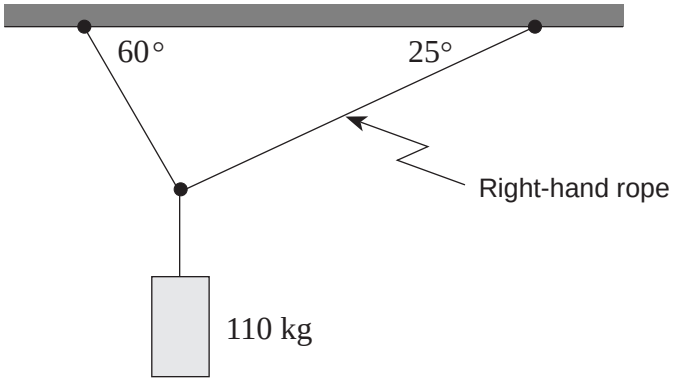
8. A $0.080\ \text{kg}$ tennis ball travelling east at $15\ \text{m/s}$ is struck by a tennis racquet, giving it a velocity of $25\ \text{m/s}$, west. What are the magnitude and direction of the impulse given to the ball?

	MAGNITUDE	DIRECTION
A.	$0.80\ \text{N} \cdot \text{s}$	Eastward
B.	$0.80\ \text{N} \cdot \text{s}$	Westward
C.	$3.2\ \text{N} \cdot \text{s}$	Eastward
D.	$3.2\ \text{N} \cdot \text{s}$	Westward

9. A body is in rotational equilibrium when

   A. $\Sigma\tau = 0$
   B. $\Sigma F = 0$
   C. $\Sigma p = 0$
   D. $\Sigma E_k = 0$

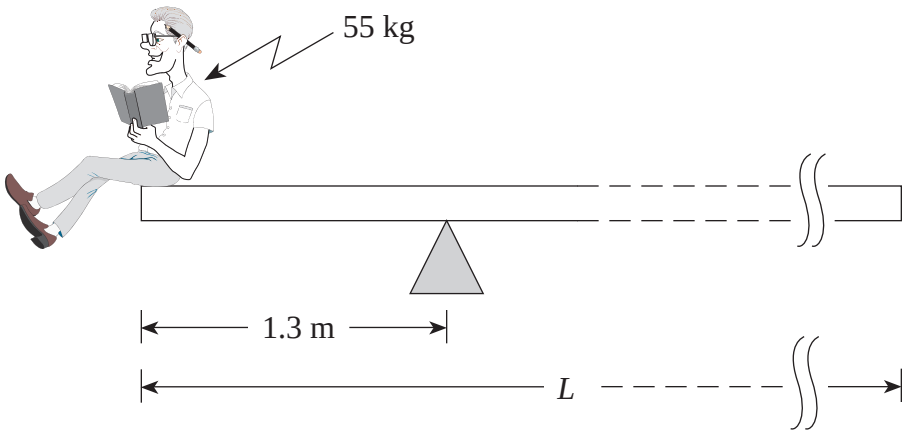
10. A $110\ \text{kg}$ object is supported by two ropes attached to the ceiling. What is the tension T in the right-hand rope?



   A. 460 N
   B. 540 N
   C. 930 N
   D. 1 300 N

OVER

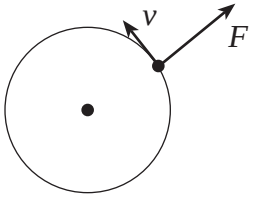
11. A 35 kg uniform plank is balanced at one end by a 55 kg student as shown.

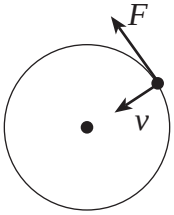


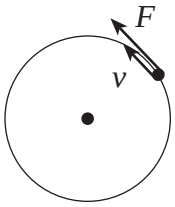
What is the overall length of this plank?

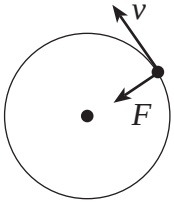
A. 2.6 m
B. 3.3 m
C. 5.4 m
D. 6.7 m

12. Which of the following diagrams shows the instantaneous velocity v and centripetal force F for an object in uniform circular motion.

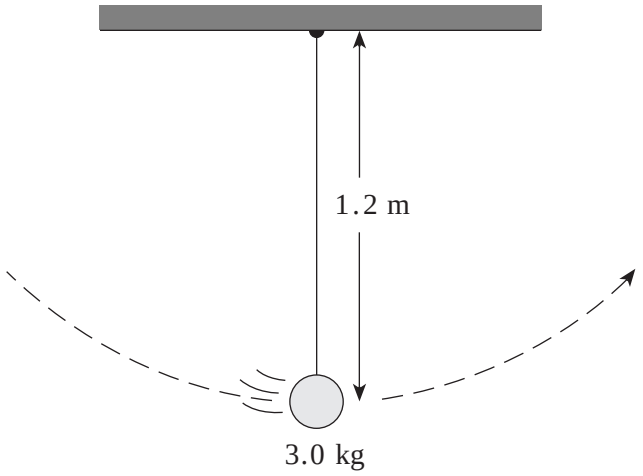
A.


B.


C.


D.


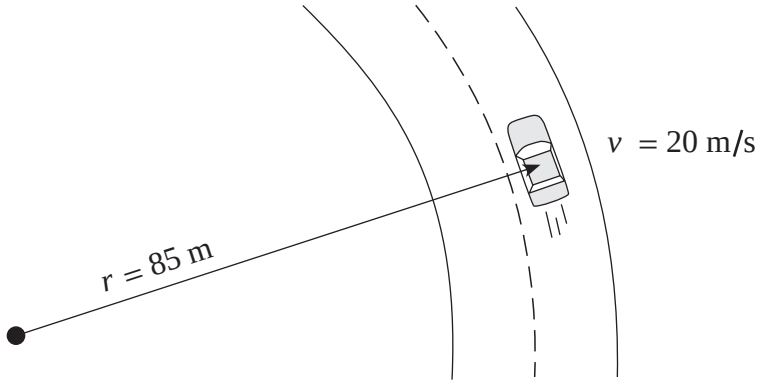
13. A 1.2 m long pendulum reaches a speed of 4.0 m/s at the bottom of its swing.



What is the tension in the string at this position?

A. 11 N
B. 29 N
C. 40 N
D. 69 N

14. A 1 200 kg car rounds a flat circular section of road at 20 m/s as shown in the diagram.



The coefficient of friction between the car tires and the road surface is 0.65. What minimum friction force is required for the car to follow this curve?

A. 3.7×10^{3} N
B. 5.6×10^{3} N
C. 7.6×10^{3} N
D. 1.2×10^{4} N

OVER

15. A satellite's orbit is maintained by a

A. normal force.
B. frictional force.
C. centrifugal force.
D. gravitational force.

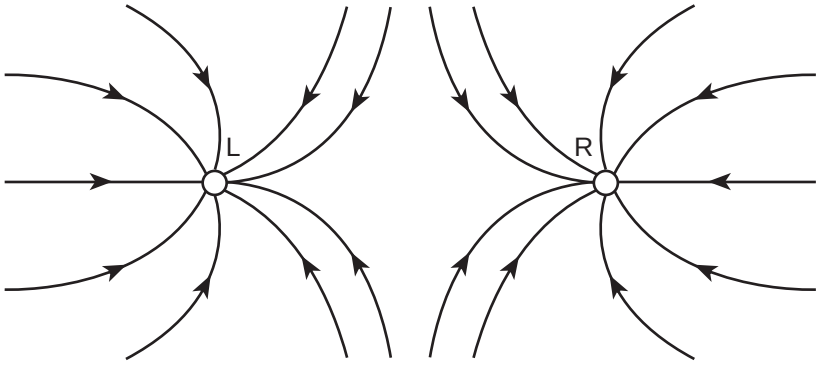
16. What is the gravitational field strength on the surface of a planetoid with a mass of 7.4×10^{22} kg and a radius of 1.7×10^{6} m.

A. 0.69 N/kg
B. 1.7 N/kg
C. 9.8 N/kg
D. 2.9×10^{6} N/kg

17. A 1 500 kg satellite is in a stable orbit at an altitude of 4.0×10^{5} m above Earth's surface. What is the satellite's total energy in this orbit?

A. -8.8×10^{10} J
B. -4.4×10^{10} J
C. 4.4×10^{10} J
D. 5.0×10^{10} J

18. The diagram shows the electric field lines near two point charges, L and R. Identify the polarity of these point charges.



	POLARITY OF L	POLARITY OF R
A.	Negative	Negative
B.	Negative	Positive
C.	Positive	Negative
D.	Positive	Positive

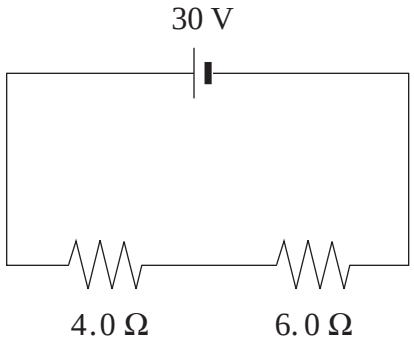
19. An electron orbits a nucleus which carries a charge of $+9.6\times10^{-19}$ C. If the electron's orbital radius is 2.0×10^{-10} m, what is its electric potential energy?

A. -6.9×10^{-18} J
B. -3.5×10^{-8} J
C. 43 J
D. 2.2×10^{11} J

20. Which household electrical appliance consumes the least energy in a typical month?

A. Stove
B. Dryer
C. Clock
D. Refrigerator

21. What is the power output of the $6.0\ \Omega$ resistor in the diagram?



A. 36 W
B. 54 W
C. 90 W
D. 150 W

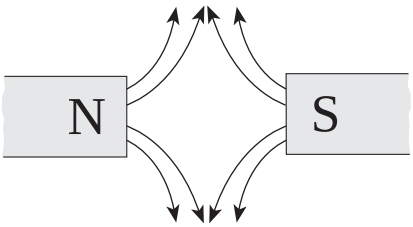
22. A 12 V power supply is connected to an $8.0\ \Omega$ resistor for 50 s. How much charge passes through the resistor?

A. 1.9 C
B. 75 C
C. 900 C
D. 4 800 C

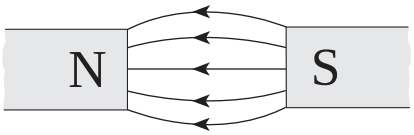
OVER

23. Which of the following diagrams best shows the magnetic field lines between the poles of two permanent magnets?

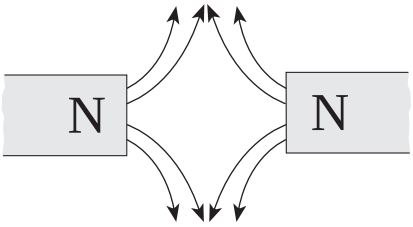
A.



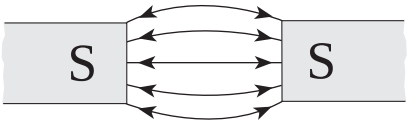
B.



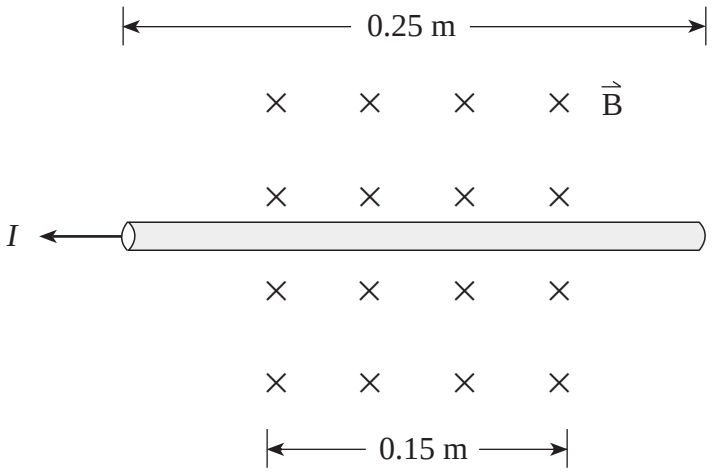
C.



D.



24. A wire carrying $12\ \text{A}$ of current is placed in a magnetic field of strength $0.63\ \text{T}$.



What are the magnitude and direction of the magnetic force acting on the wire?

	FORCE	DIRECTION
A.	1.1 N	down the page
B.	1.1 N	up the page
C.	1.9 N	down the page
D.	1.9 N	up the page

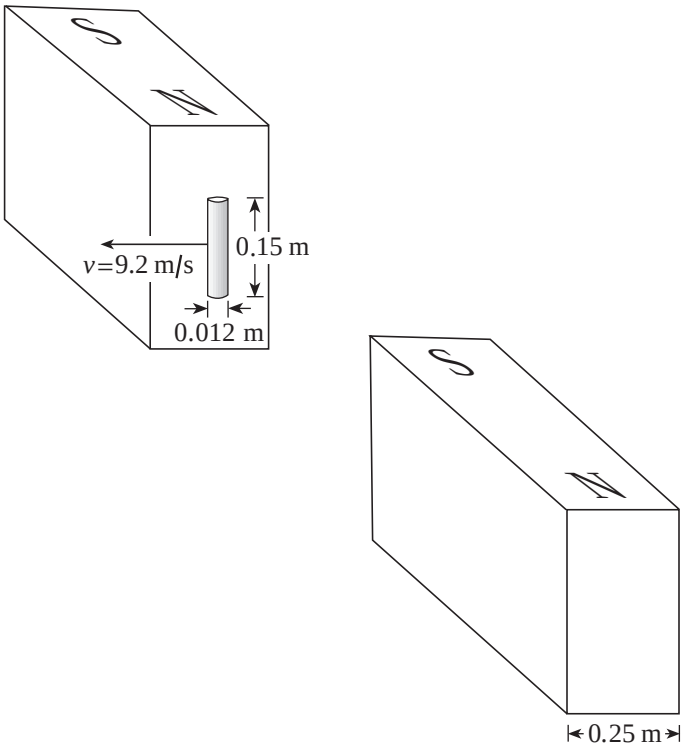
25. A particle having a charge of 3.2×10^{-19} C follows a circular path of 0.45 m radius while travelling at a speed of 1.2×10^{4} m/s in a 0.78 T magnetic field. What is the mass of the particle?

A. 7.8×10^{-28} kg
B. 9.4×10^{-24} kg
C. 1.1×10^{-19} kg
D. 3.0×10^{-15} kg

26. A 460-turn solenoid having a diameter of 0.024 m is 0.14 m long. What is the magnetic field at the centre of the solenoid when a 13 A current flows through it?

A. 0 T
B. 5.4×10^{-2} T
C. 3.1×10^{-1} T
D. 6.3×10^{-1} T

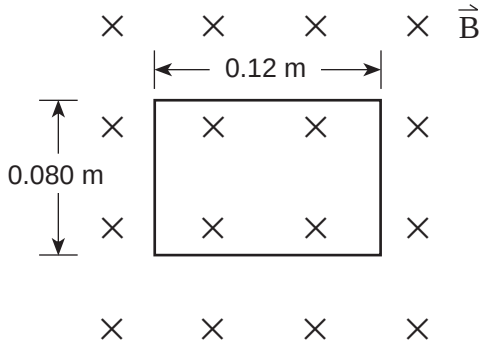
27. A conducting rod is moving perpendicular to a uniform magnetic field of 0.23 T at a velocity of 9.2 m/s. What emf is generated during this motion?



A. 0 V
B. 0.025 V
C. 0.32 V
D. 0.53 V

OVER

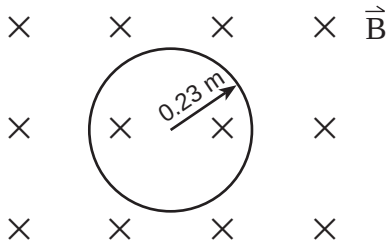
28. A rectangular coil measuring 0.12 m by 0.080 m is placed perpendicular to a 0.85 T magnetic field as shown.



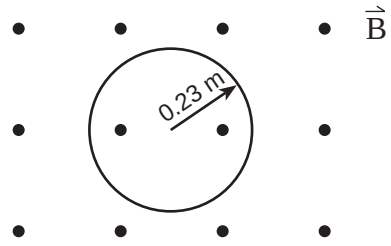
What is the magnetic flux through the coil?

A. 0 Wb
B. 8.2×10^{-3} Wb
C. 6.8×10^{-2} Wb
D. 1.0×10^{-1} Wb

29. A single loop of wire of radius 0.23 m is placed in a 0.75 T magnetic field as shown. The magnetic field is changed to a strength of 0.50 T in the opposite direction in 0.61 s.



Before

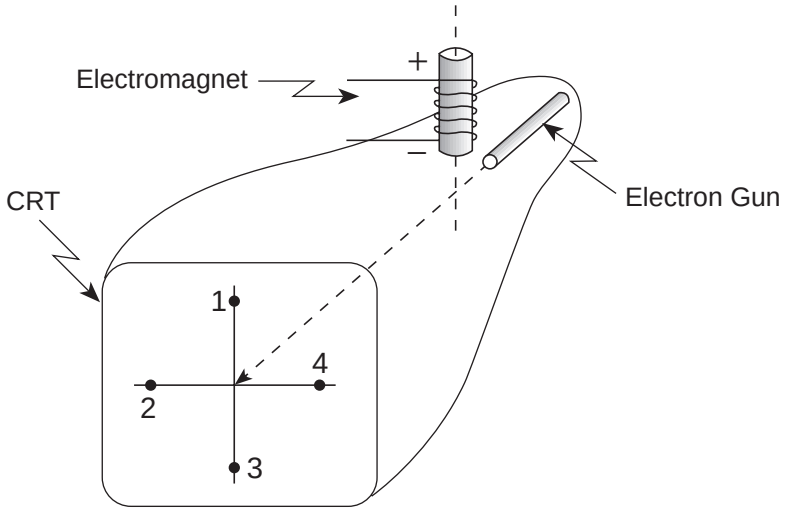


After

What is the average emf induced in the coil?

A. 0.068 V
B. 0.094 V
C. 0.34 V
D. 0.47 V

30. With the electromagnet turned off, electrons in a cathode ray tube strike the centre of the screen as shown.



When the electromagnet is turned on, where will the electron beam now strike the screen?

A. 1
B. 2
C. 3
D. 4

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

OVER

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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.

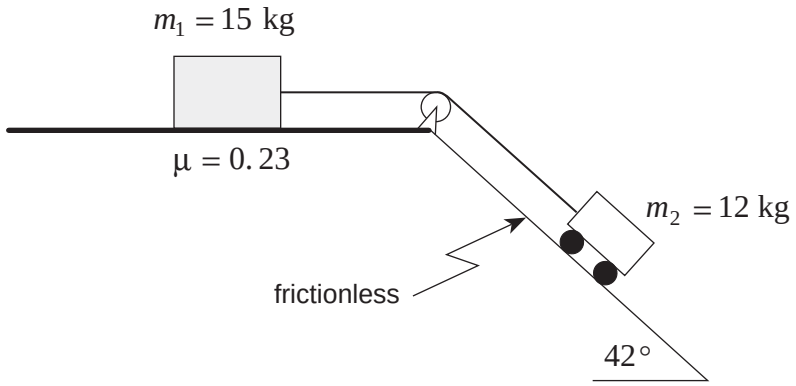
3. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution.

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.**

OVER

1. Two objects are connected as shown. The $12\ \text{kg}$ cart is on a frictionless $42°$ incline while the $15\ \text{kg}$ block is on a horizontal surface having a coefficient of friction $\mu = 0.23$.



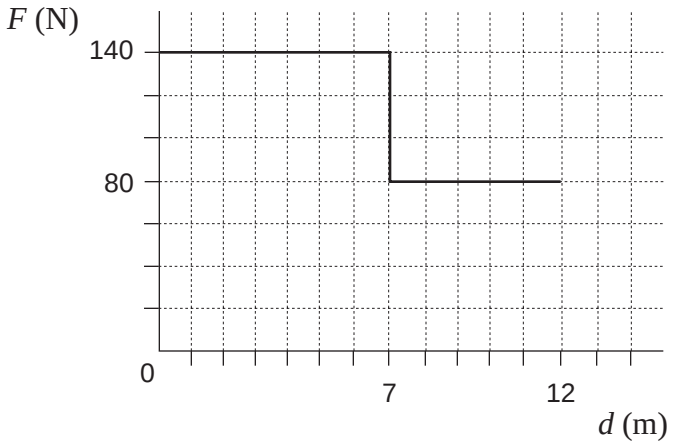
Determine the acceleration of the system of masses. **(7 marks)**

ANSWER:

acceleration: _____

OVER

2. Starting from rest, a farmer pushed a cart 12 m. The graph shows the force *F* which he applied, plotted against the distance *d*.



a) How much work did the farmer do moving the cart 12 m? **(3 marks)**

b) After the farmer had pushed the 240 kg cart 12 m, it was moving with a velocity of 2.2 m/s. What was the cart's kinetic energy? **(2 marks)**

c) What was the efficiency of this process? **(2 marks)**

ANSWER:

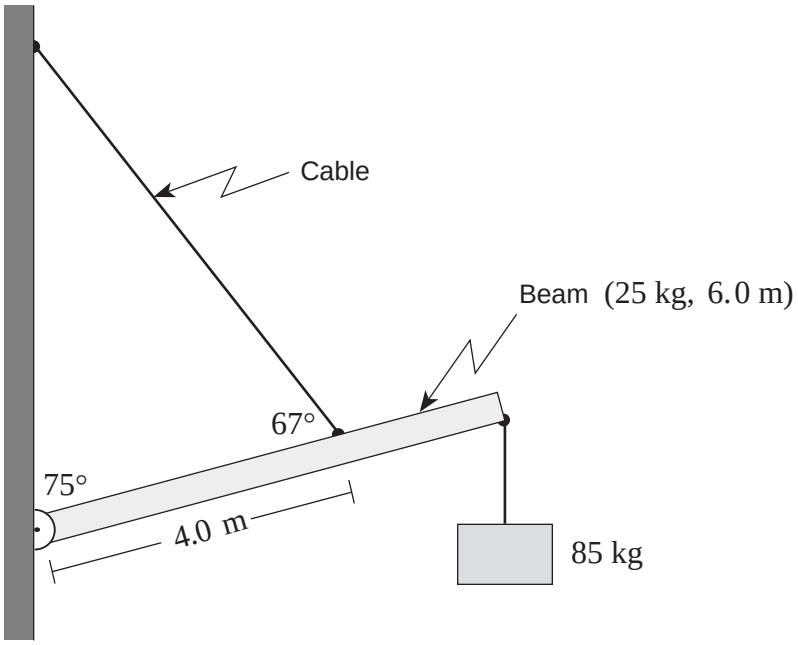
a) work: _____

b) kinetic energy: _____

c) efficiency: _____

OVER

3. A 6.0 m uniform beam of mass 25 kg is suspended by a cable as shown. An 85 kg object hangs from one end.



What is the tension in the cable? **(7 marks)**

ANSWER:

tension: _____

OVER

4. The moon Titan orbits the planet Saturn with a period of 1.4×10^6 s. The average radius of this orbit is 1.2×10^9 m.

   a) What is Titan's centripetal acceleration? **(2 marks)**

b) Calculate Saturn's mass. **(5 marks)**

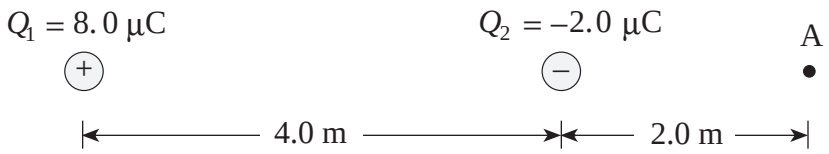
ANSWER:

a) acceleration: _____

b) mass: _____

OVER

5. Two charges are positioned as shown in the diagram below.



a) Find the magnitude and direction of the electric field at A. (Note: $1.0\ \mu C = 1.0 \times 10^{-6}$ C)

(4 marks)

b) A charge placed at A experiences a force of 4.0×10^{-3} N towards the right. What are the magnitude and polarity of this charge? **(3 marks)**

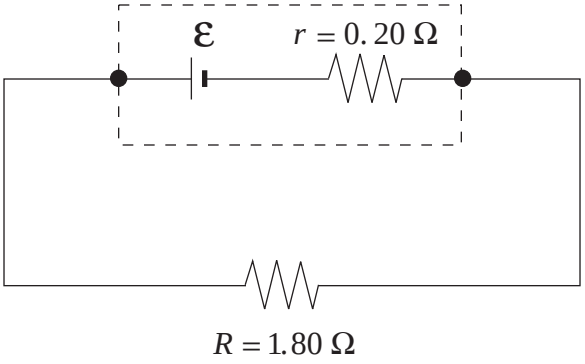
ANSWER:

a) magnitude of electric field: _____
direction of electric field: _____

b) charge: _____

OVER

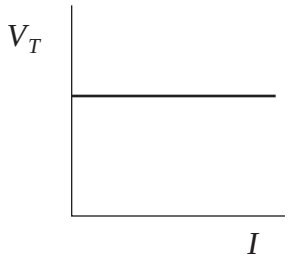
6. The cell shown delivers a $1.50\ \text{A}$ current to the external circuit and has a terminal voltage of $2.70\ \text{V}$.



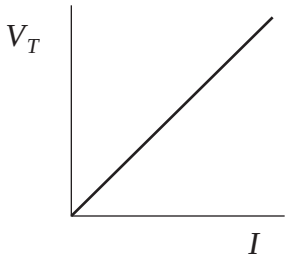
a) What is the emf of the cell? **(4 marks)**

b) The $1.80\ \Omega$ external resistance is replaced by other resistors and the current and terminal voltage are measured in each case. Which graph best represents terminal voltage V_T versus current I as these resistors are changed? **(2 marks)**

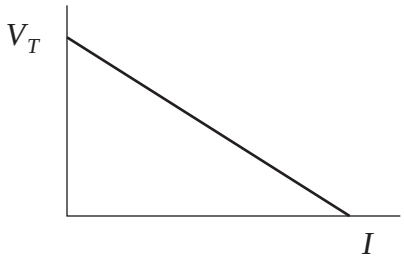
Graph I



Graph II



Graph III



- ☐ Graph I
- ☐ Graph II
- ☐ Graph III

(Check one response.)

c) Using principles of physics, explain your answer to b). **(3 marks)**

ANSWER:

a) emf: _____

OVER

7. An electric device operates on 9.0 V ac and has a total resistance of $21\,\Omega$. An ideal transformer is used to change the incoming line voltage of 120 V ac to the operating voltage of 9.0 V ac.

a) Is the transformer a step-up or step-down transformer? **(1 mark)**

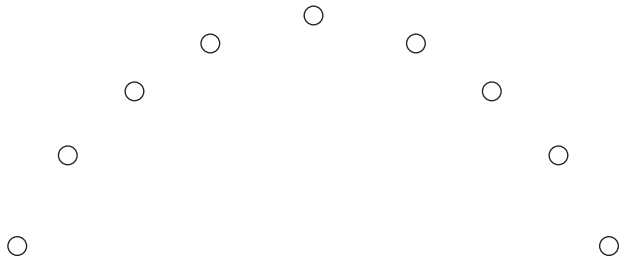
b) What is the current in the primary side? **(6 marks)**

ANSWER:

b) current: _____

OVER

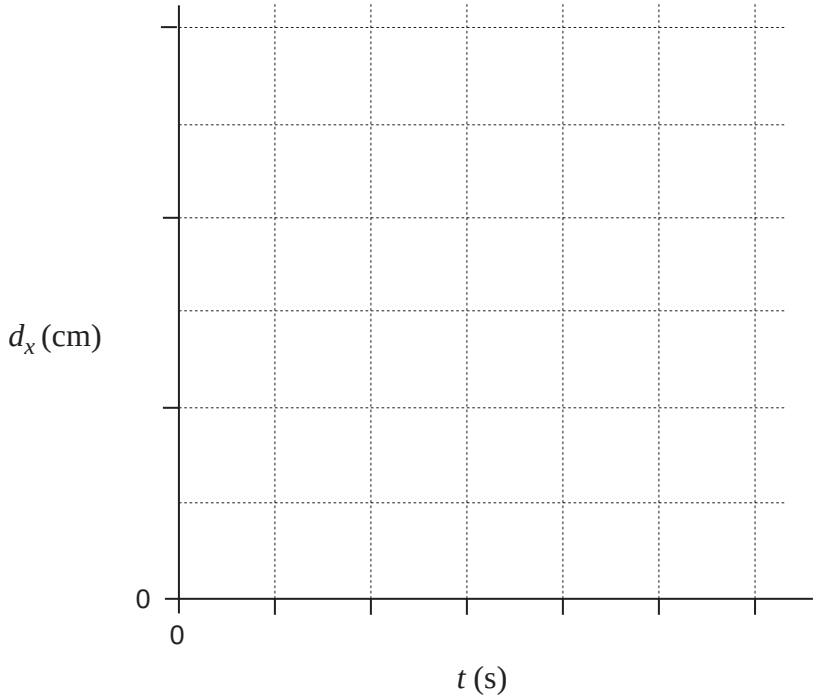
8. A student collects data from the path of a projectile similar to that shown in the diagram.



The student records the following data for horizontal displacement from the initial launch position as a function of time.

d_x (cm)	0.0	0.5	0.9	1.5	1.9	2.5	3.1
t (s)	0.000	0.020	0.040	0.060	0.080	0.100	0.120

a) Plot a graph of d_x vs. t on the graph below. **(2 marks)**



b) Calculate the slope of the line, expressing the answer in appropriate units. **(2 marks)**

c) Based on this data and graph, make a statement about the behaviour of projectiles.
(1 mark)

_____

_____

ANSWER:

b) slope: _____

OVER

9. Consider the collision between the vehicles in the photograph below.

The collision is inelastic. Define inelastic. Give at least two pieces of evidence that show this to be an inelastic collision. **(4 marks)**

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	$= 9.80\ \text{m/s}^2$
Earth		
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		$= 5.98 \times 10^{24}\ \text{kg}$
Moon		
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		$= 7.35 \times 10^{22}\ \text{kg}$
Sun		
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	μ_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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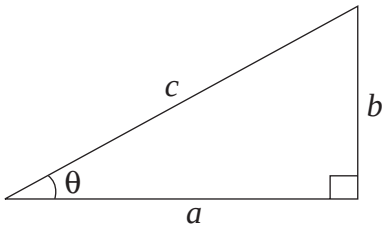
For Right-angled Triangles:

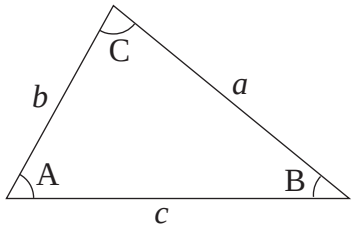


$$a^2 + b^2 = c^2$$

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

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

For All Triangles:



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

$$\sin 2\text{A} = 2\sin\text{A}\cos\text{A}$$

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

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

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:

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

Vector Kinematics in Two Dimensions:

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

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

Vector Dynamics:

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

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

Work, Energy, and Power:

$$W = Fd \qquad E_{\text{p}} = mgh$$

$$E_{\text{k}} = \frac{1}{2}mv^2 \qquad P = \frac{W}{t}$$

Momentum:

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

Equilibrium:

$$\tau = Fd$$

Circular Motion:

$$a_{\text{c}} = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

Gravitation:

$$F = G\frac{m_1 m_2}{r^2} \qquad E_{\text{p}} = -G\frac{m_1 m_2}{r}$$

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Electrostatics:

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

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

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

Electric Circuits:

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

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

Electromagnetism:

$$F = BIl \qquad F = QvB$$

$$B = \mu_0 nI = \mu_0 \frac{N}{l} I \qquad \mathcal{E} = Blv$$

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

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

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

ROUGH WORK FOR MULTIPLE-CHOICE

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INSERT STUDENT I.D. NUMBER (PEN)

STICKER IN THIS SPACE

PHYSICS 12

January 1999

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PHYSICS 12

January 1999

Course Code = PH

Score for Question 1:	Score for Question 8:
1. _____ (7)	8. _____ (5)

Score for Question 2:	Score for Question 9:
2. _____ (7)	9. _____ (4)

Score for Question 3:
3. _____ (7)

Score for Question 4:
4. _____ (7)

Score for Question 5:
5. _____ (7)

Score for Question 6:
6. _____ (9)

Score for Question 7:
7. _____ (7)