BRITISH COLUMBIA
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Physics 12

Examination Booklet
August 2007

Form A

DO NOT OPEN ANY EXAMINATION MATERIALS UNTIL INSTRUCTED TO DO SO.

FOR FURTHER INSTRUCTIONS REFER TO THE RESPONSE BOOKLET.

Contents: 16 pages
35 multiple-choice questions

Examination: 2 hours
Additional Time Permitted: 60 minutes

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PART A: MULTIPLE CHOICE
Value: 70% of the examination

Suggested Time: 70 minutes

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

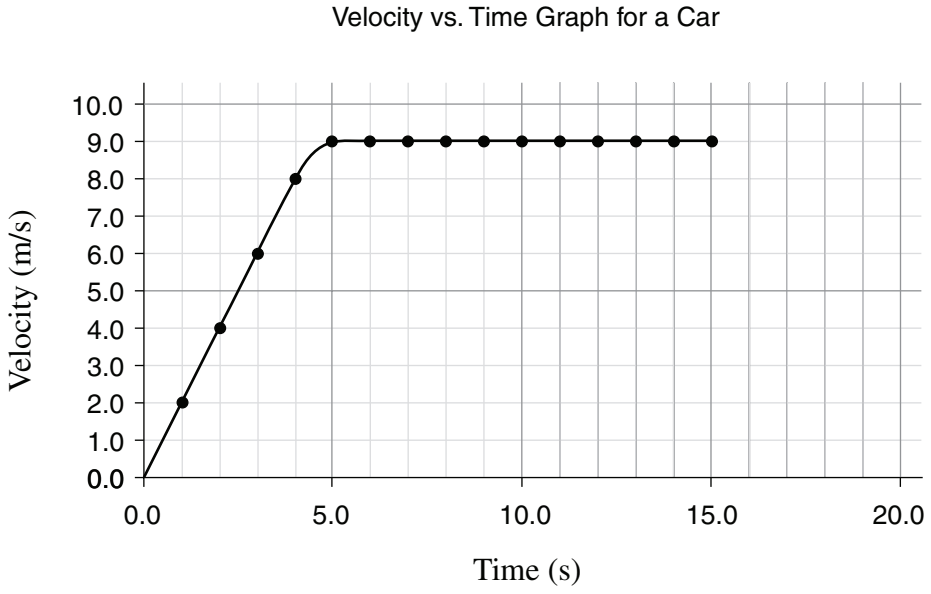
You have **Examination Booklet Form A**. In the box above #1 on your **Answer Sheet**, fill in the bubble as follows.

Exam Booklet Form/ Cahier d'examen	A	B	C	D	E	F	G	H
	●	○	○	○	○	○	○	○

1. Which one of the following contains two vectors?

   A. time, distance
   B. time, acceleration
   C. velocity, distance
   D. velocity, acceleration

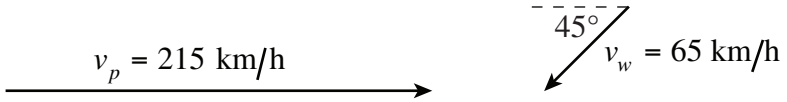
2. A car's motion is described by the velocity versus time graph shown below.



What is the total distance travelled by the car during its motion?

   A. 45 m
   B. 90 m
   C. 110 m
   D. 140 m

3. An airplane heading due east at 215 km/h is blown off course by a strong wind of 65 km/h blowing 45° south of west.



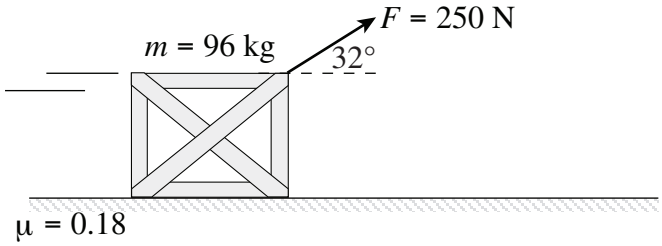
What is the resultant speed of the plane?

A. 150 km/h
B. 180 km/h
C. 260 km/h
D. 280 km/h

4. Which of the following is another expression for gravitational field strength?

A. normal force
B. force of gravity
C. centripetal acceleration
D. acceleration due to gravity

5. A 250 N force is applied at an angle of 32° above the horizontal to a 96 kg wooden box causing it to slide along a floor as shown.

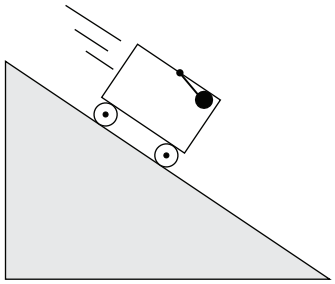


The coefficient of friction between the floor and the box is 0.18. What is the magnitude of the net force on the wooden box?

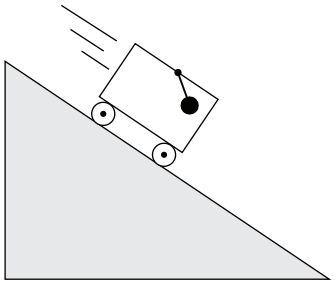
A. 43 N
B. 67 N
C. 81 N
D. 210 N

6. A small metal sphere is hung by a string from the ceiling of a cart. Which of the following shows the correct position of the metal sphere, as the cart is accelerating down the frictionless incline?

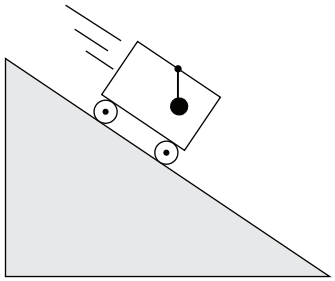
A.



B.



C.



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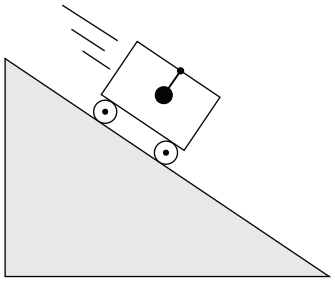
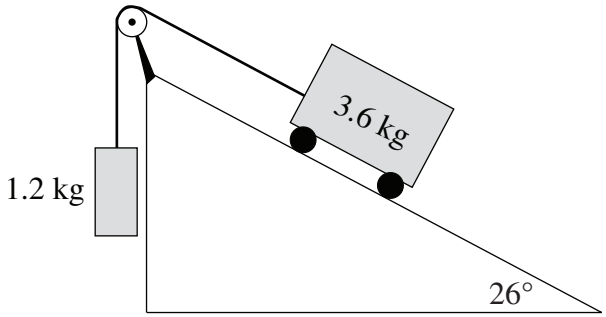


7. A 1.2 kg mass is connected via a pulley to a 3.6 kg cart sitting on a frictionless incline as shown.



Which of the following is correct, if the 3.6 kg cart is allowed to move freely?

	MAGNITUDE OF ACCELERATION	DIRECTION OF ACCELERATION
A.	0.77 m/s^2	up the incline
B.	0.77 m/s^2	down the incline
C.	1.0 m/s^2	up the incline
D.	1.0 m/s^2	down the incline

8. A 5500 kg aircraft initially at rest took 920 s to climb to a cruising altitude of 9500 m and a cruising speed of 210 m/s. What was the minimum average power required from the aircraft's engines during this time?

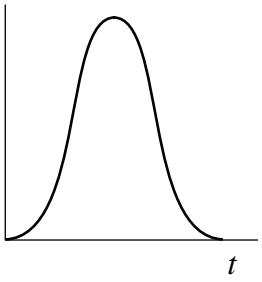
A. 1.3×10^5 W

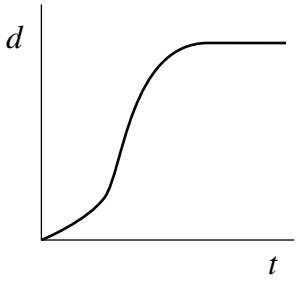
B. 5.6×10^5 W

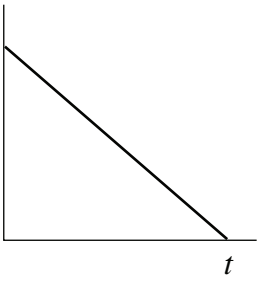
C. 6.9×10^5 W

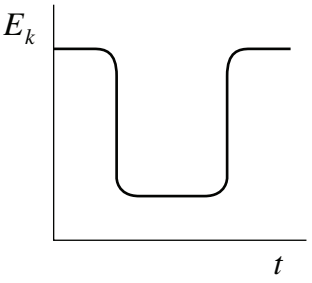
D. 6.3×10^8 W

9. The area under which graph best represents the impulse delivered by a tennis racket to a ball?

A. 

B. 

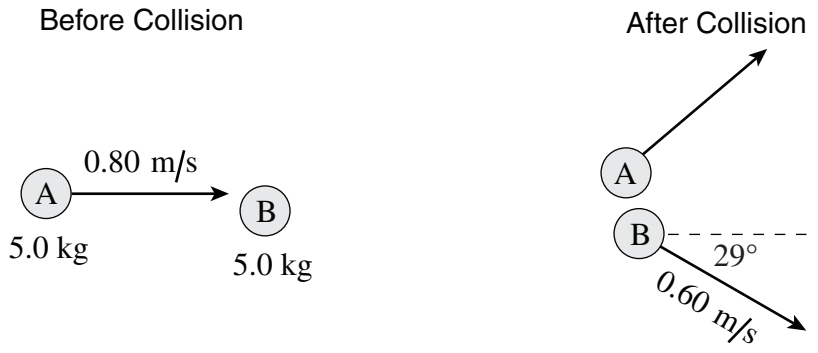
C. 

D. 

10. A 2.0 kg cart travelling east at $4.0\ \text{m/s}$ strikes a stationary 8.0 kg cart. After the collision, the 2.0 kg cart bounces back towards the west at $2.0\ \text{m/s}$, while the 8.0 kg cart travels east at $1.5\ \text{m/s}$. Which of the following is the change in momentum for each cart?

	2.0 kg CART $\Delta p\ (\text{kg} \cdot \text{m/s})$	8.0 kg CART $\Delta p\ (\text{kg} \cdot \text{m/s})$
A.	4.0 East	12 West
B.	4.0 West	12 East
C.	12 East	12 West
D.	12 West	12 East

11. A 5.0 kg puck (A) moving at $0.80\ \text{m/s}$ to the right collides obliquely with an identical stationary puck (B). Puck B then moves at $0.60\ \text{m/s}$ as shown.



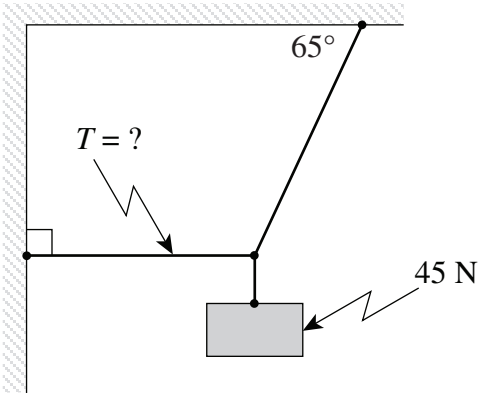
What is the magnitude of the momentum of puck A after the collision?

A. $1.0\ \text{kg} \cdot \text{m/s}$
B. $2.0\ \text{kg} \cdot \text{m/s}$
C. $3.0\ \text{kg} \cdot \text{m/s}$
D. $5.0\ \text{kg} \cdot \text{m/s}$

12. Which of the following is a torque expression?

A. $\tau = ma$
B. $\tau = m\Delta v$
C. $\tau = v \sin\theta$
D. $\tau = F \sin\theta \cdot d$

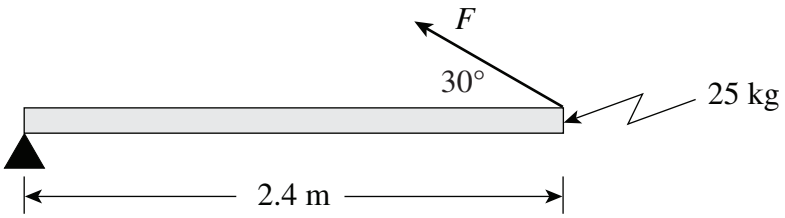
13. A 45 N block is suspended as shown in the diagram.



What is the tension, T, in the horizontal cable?

A. 19 N
B. 21 N
C. 23 N
D. 97 N

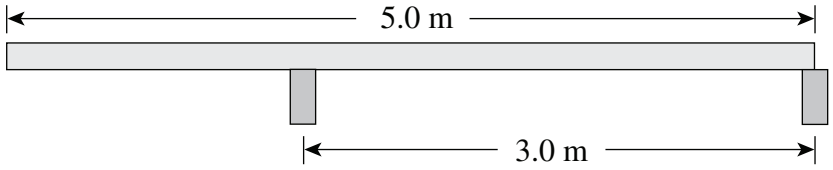
14. A uniform 2.4 m long beam with a mass of 25 kg is kept horizontal by a force F.



What is the magnitude of the force F?

A. 1.2×10^2 N
B. 1.4×10^2 N
C. 2.5×10^2 N
D. 4.9×10^2 N

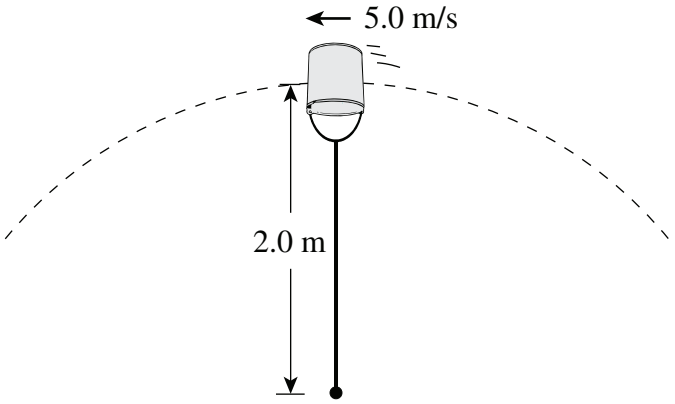
15. A uniform plank, 5.0 m long and with a mass of 15 kg, rests on two supports as shown.



What force does the left-hand support exert on the plank?

A. 74 N
B. 88 N
C. 123 N
D. 147 N

16. A 4.0 kg bucket of paint tied to a rope is being swung in a vertical circle with a radius of 2.0 m. The speed of the bucket at the top of its swing is 5.0 m/s.



What is the tension in the rope at this point?

A. 11 N
B. 39 N
C. 50 N
D. 89 N

17. Two objects of unequal mass are dropped from the same height near the surface of the earth. Which of the following is the same for both objects just before they hit the surface? (Ignore friction.)

A. velocity
B. net force
C. momentum
D. kinetic energy

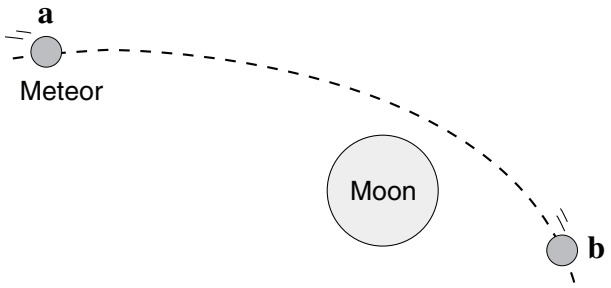
18. What is the gravitational field strength on the surface of a moon with a mass of 3.7×10^{21} kg and a radius of 8.4×10^{5} m ?

A. 0.35 N/kg
B. 9.8 N/kg
C. 540 N/kg
D. 2.9×10^{5} N/kg

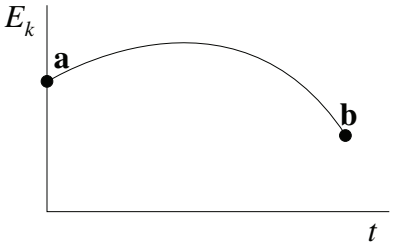
19. What is the speed required to maintain a stable orbit around a planet of mass 2.5×10^{27} kg at a radius (from the centre of the planet) of 8.5×10^{7} m ?

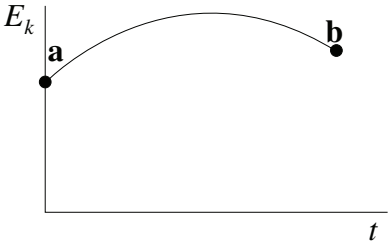
A. 23 m/s
B. 3.3×10^{4} m/s
C. 4.4×10^{4} m/s
D. 9.8×10^{8} m/s

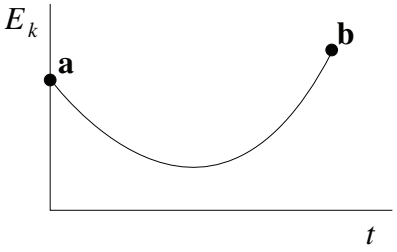
20. A meteor passes by a moon as shown below.

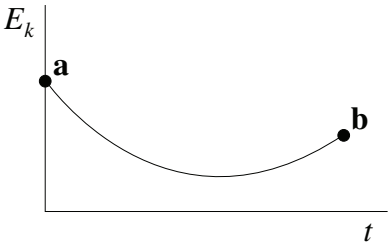


Which E_k versus time graph best shows how the kinetic energy of the meteor changes from position **a** to position **b**?

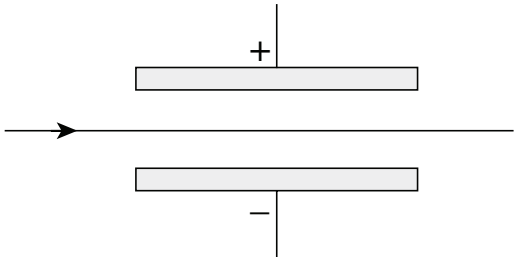
A.


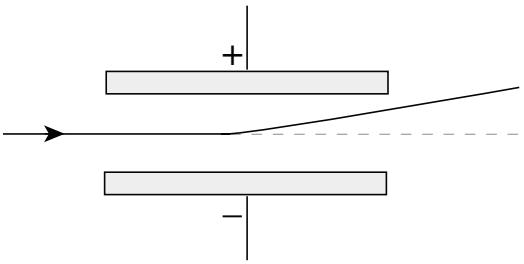
B.


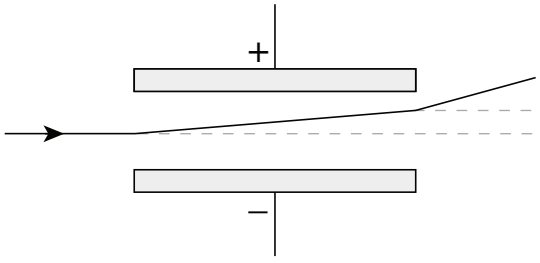
C.


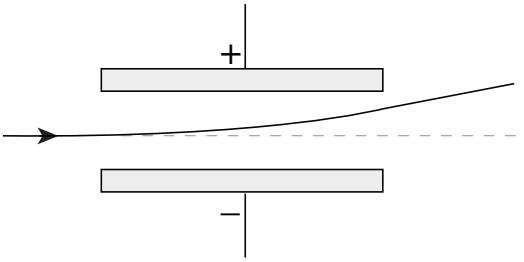
D.


21. Which diagram best represents the path of an electron travelling between charged parallel plates?

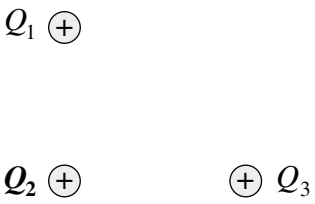
A.


B.


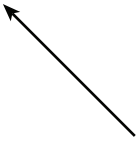
C.


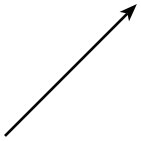
D.


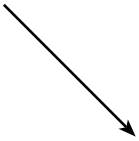
22. Three identical positive charges are arranged as shown.



What is the direction of the electric force on Q_2?

A. 

B. 

C. 

D. 

23. What is the electric force on an electron in the region between parallel plates that are 4.0 cm apart with a 250 V potential difference?

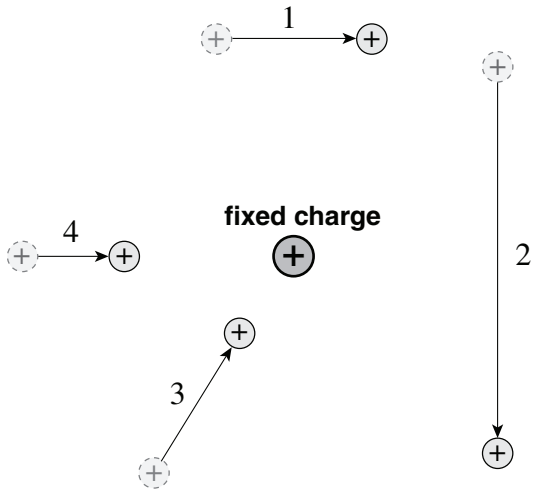
A. 0 N

B. 1.6×10^{-18} N

C. 1.0×10^{-15} N

D. 6.3×10^{3} N

24. A small sphere with an electric charge may be moved in four different ways near a fixed electric charge.



Which displacement requires the most work?

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

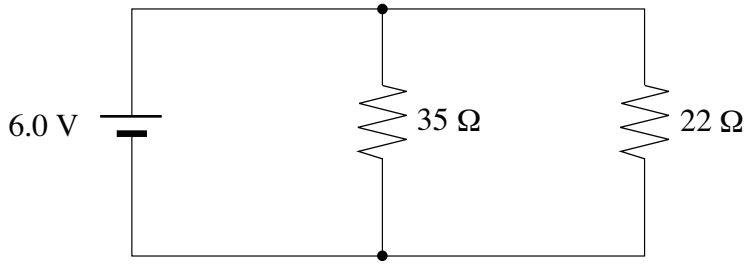
25. An electric charge accelerated from rest through a potential difference of 250 V reaches a speed of 9.4×10^6 m/s . What speed will this same charge reach if it is accelerated by a potential difference of 125 V?

A. 4.7×10^6 m/s
B. 6.6×10^6 m/s
C. 9.4×10^6 m/s
D. 1.3×10^7 m/s

26. In an electric circuit, 6.25×10^{18} electrons flow past one point in 0.10 s. What is the current?

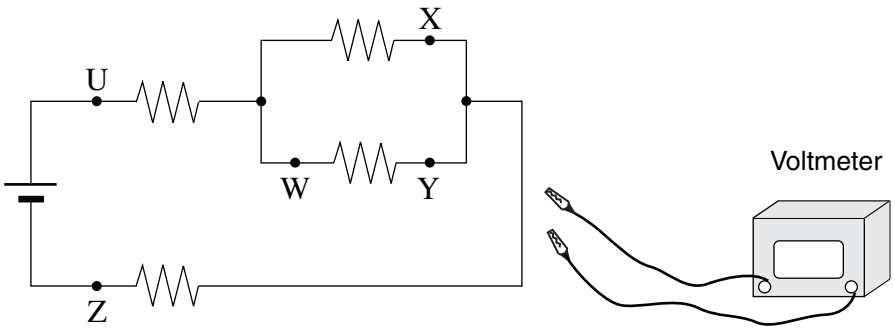
A. 1.6×10^{-19} A
B. 1.0 A
C. 10 A
D. 6.25×10^{19} A

27. What current would be drawn from the power supply in the circuit shown below?



A. 0.11 A
B. 0.17 A
C. 0.27 A
D. 0.44 A

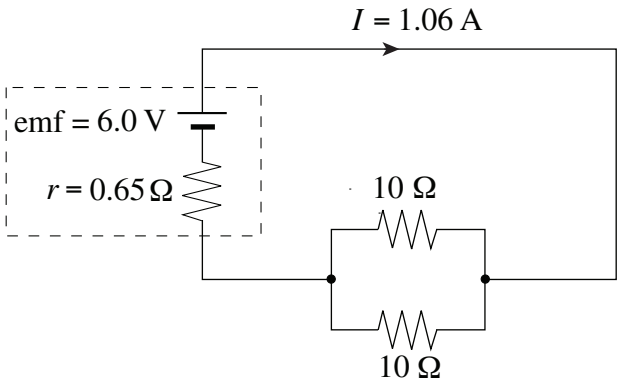
28. A student needs to connect a voltmeter to measure the potential difference across the parallel resistors in the circuit shown below.



Across which two connection points should the student connect the voltmeter?

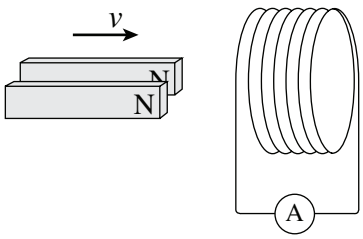
A. U and Z
B. X and Y
C. X and W
D. W and Z

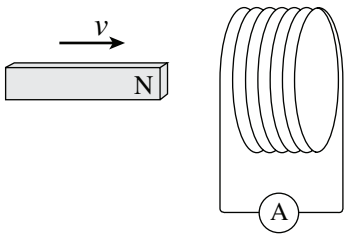
29. What is the terminal voltage of the battery in the circuit shown?

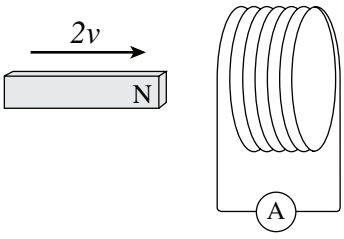


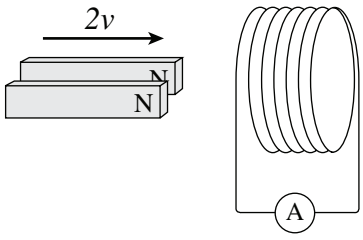
A. 0.69 V
B. 5.3 V
C. 6.0 V
D. 6.7 V

30. Which of the following situations induces the greatest current flow in the coil? (All magnets and coils are identical.)

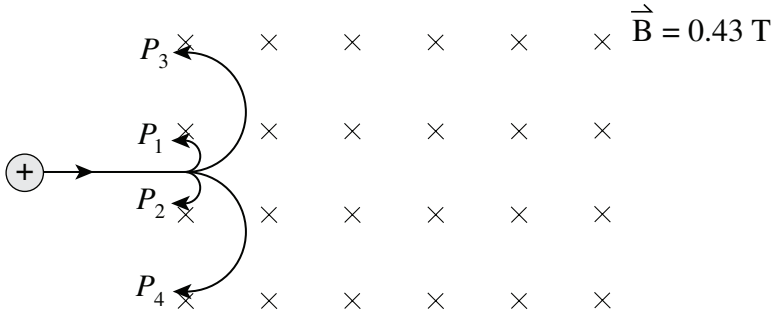
A. 

B. 

C. 

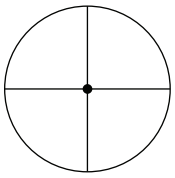
D. 

31. A proton travelling at 2.0×10^6 m/s enters a 0.43 T magnetic field. Which of the paths shown in the diagram will the proton follow? (Diagram is not to scale.)



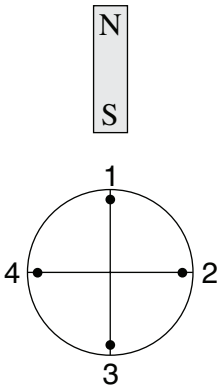
A. P_1, radius = 2.6×10^{-5} m
B. P_2, radius = 2.6×10^{-5} m
C. P_3, radius = 0.049 m
D. P_4, radius = 0.049 m

32. An electron beam strikes the centre of a CRT screen as shown.



Front view of screen

A magnet is then placed near the CRT.

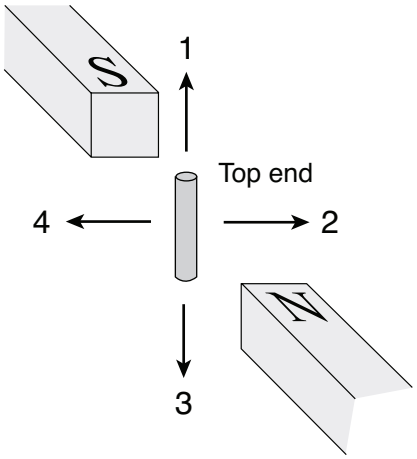


Front view of screen

Which of the four dots shows the new position of the electron beam?

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

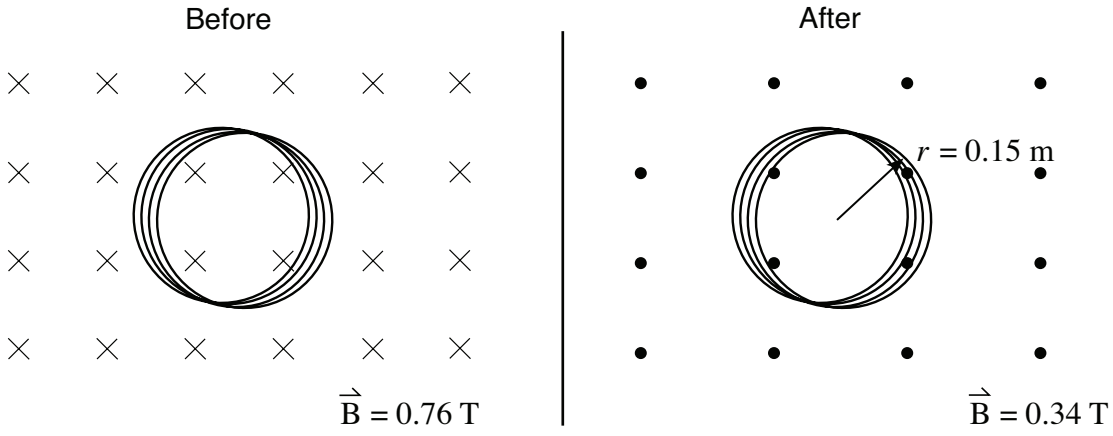
33. A conductor is initially at rest in a magnetic field.



In which direction should the conductor be moved so that its top end becomes positively charged?

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

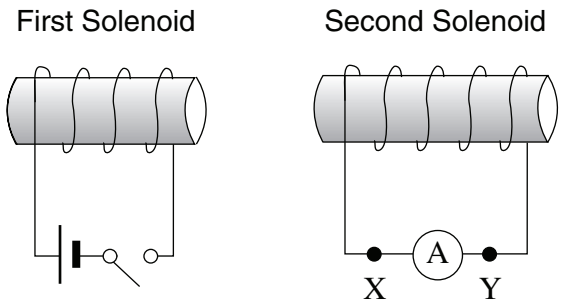
34. A 55-turn circular coil of wire of radius 0.15 m is placed in a 0.76 T magnetic field as shown. The magnetic field changes to 0.34 T in the opposite direction in a time of 0.25 s.



What is the average induced emf in the coil during the change in magnetic field?

A. 6.5 V
B. 14 V
C. 17 V
D. 36 V

35. Two solenoids are placed close together as shown.



As the switch is closed, what is the direction of the current through the ammeter, and what is the direction of the induced magnetic field inside the second solenoid?

	DIRECTION OF CURRENT THROUGH AMMETER	DIRECTION OF INDUCED MAGNETIC FIELD INSIDE THE SECOND SOLENOID
A.	From X to Y	Left
B.	From X to Y	Right
C.	From Y to X	Left
D.	From Y to X	Right

You have **Examination Booklet Form A**. In the box above #1 on your **Answer Sheet**, ensure you filled in the bubble as follows.

Exam Booklet Form/ Cahier d'examen	A	B	C	D	E	F	G	H
	●	○	○	○	○	○	○	○

This is the end of the multiple-choice section.
Answer the remaining questions directly in the Response Booklet.

FUNDAMENTAL CONSTANTS AND PHYSICAL DATA

Gravitational constant	G	$= 6.67 \times 10^{-11}\ \text{N} \cdot \text{m}^2/\text{kg}^2$
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	$= 1.67 \times 10^{-27}\ \text{kg}$
Permeability of free space	μ_o	$= 4\pi \times 10^{-7}\ \text{T} \cdot \text{m/A}$
Speed of light	c	$= 3.00 \times 10^{8}\ \text{m/s}$

Earth

radius		$= 6.38 \times 10^{6}\ \text{m}$
mass		$= 5.98 \times 10^{24}\ \text{kg}$
acceleration due to gravity at the surface of Earth (for the purposes of this examination)	g	$= 9.80\ \text{m/s}^2$
period of rotation		$= 8.61 \times 10^{4}\ \text{s}$
radius of orbit around Sun		$= 1.50 \times 10^{11}\ \text{m}$
period of orbit around Sun		$= 3.16 \times 10^{7}\ \text{s}$

Moon

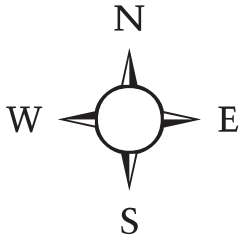
radius		$= 1.74 \times 10^{6}\ \text{m}$
mass		$= 7.35 \times 10^{22}\ \text{kg}$
period of rotation		$= 2.36 \times 10^{6}\ \text{s}$
radius of orbit around Earth		$= 3.84 \times 10^{8}\ \text{m}$
period of orbit around Earth		$= 2.36 \times 10^{6}\ \text{s}$

Sun

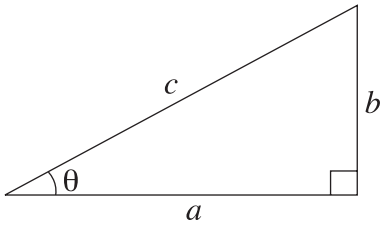
mass		$= 1.98 \times 10^{30}\ \text{kg}$

MATHEMATICAL FORMULAE

METRIC PREFIXES			
Prefix	**Symbol**	**Numerical**	**Exponential**
mega	M	1 000 000	10^6
kilo	k	1 000	10^3
hecto	h	100	10^2
deca	da	10	10^1
		1	10^0
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	μ	0.000001	10^{-6}



For Right-angled Triangles:

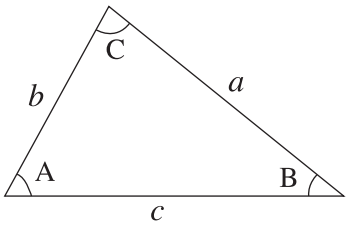


$$a^2 + b^2 = c^2$$

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

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

For All Triangles:



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

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

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

Circle:

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

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

Quadratic Equation:

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

PHYSICS FORMULAE

Vector Kinematics in Two Dimensions:

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

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

Vector Dynamics:

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

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

Work, Energy, and Power:

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

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

Momentum:

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

Equilibrium:

$$\tau = Fd$$

Circular Motion:

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

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

Gravitation:

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

Electrostatics:

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

$$\Delta V = \frac{\Delta E_{\text{p}}}{Q} \qquad E = \frac{\Delta V}{d}$$

$$E_{\text{p}} = k\frac{Q_1 Q_2}{r} \qquad V = \frac{kQ}{r}$$

Electric Circuits:

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

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

Electromagnetism:

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

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

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

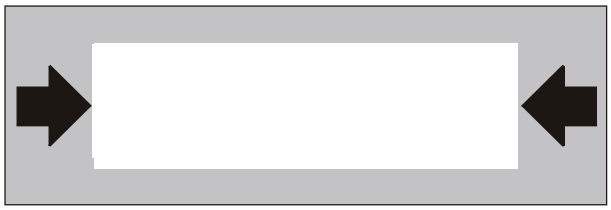
$$V_{\text{back}} = \mathcal{E} - Ir$$

$$\frac{V_{\text{s}}}{V_{\text{p}}} = \frac{N_{\text{s}}}{N_{\text{p}}} = \frac{I_{\text{p}}}{I_{\text{s}}}$$

ROUGH WORK FOR MULTIPLE-CHOICE

MINISTRY USE ONLY

Place Personal Education Number (PEN) here.



Course Code = PH 12

AUGUST 2007

Exam Booklet Form/ Cahier d'examen A B C D E F G H

Student Instructions

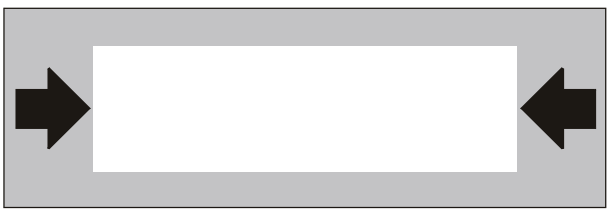
1. Place your Personal Education Number (PEN) label at the top of this Booklet **AND** fill in the bubble (Form A, B, C, D, E, F, G or H) that corresponds to the letter on your Examination Booklet.
2. Use a pencil to fill in bubbles when answering questions on your Answer Sheet.
3. Use a pencil or blue- or black-ink pen when answering written-response questions in this Booklet.
4. Read the Examination Rules on the back of this Booklet.

MINISTRY USE ONLY

Question 1	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐		(.5) ☐ NR ☐
Question 2	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐		(.5) ☐ NR ☐
Question 3	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	(.5) ☐ NR ☐
Question 4	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐		(.5) ☐ NR ☐
Question 5	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐		(.5) ☐ NR ☐
Question 6	0 ☐	1 ☐	2 ☐	3 ☐	4 ☐			NR ☐

MINISTRY USE ONLY

Place Personal Education Number (PEN) here.



Course Code = PH 12

Physics 12

AUGUST 2007

Response Booklet

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PART B: WRITTEN RESPONSE
Value: 30% of the examination

Suggested Time: 50 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.**

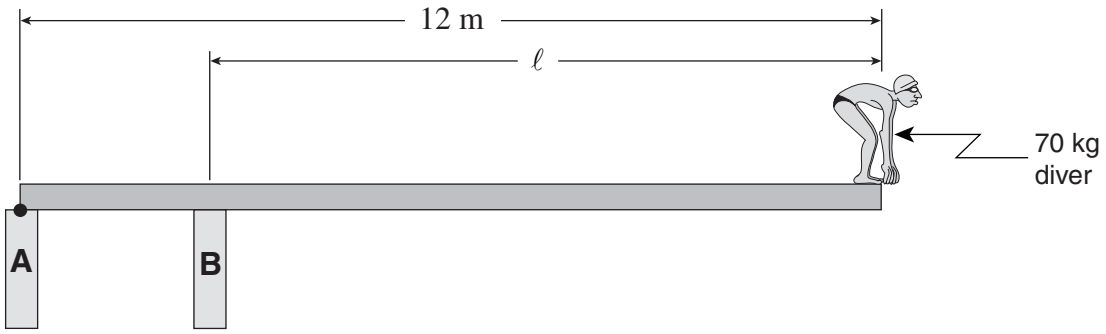
1. **(5 marks)**

A 10 kg curling stone is sliding along the ice when it hits a stationary 15 kg bucket of sand. After the collision, the curling stone's velocity is $3.0\ m/s$ east, and the bucket has a velocity of $2.2\ m/s$, $40°$ S of E.

What direction was the curling stone moving before the collision?

2. **(5 marks)**

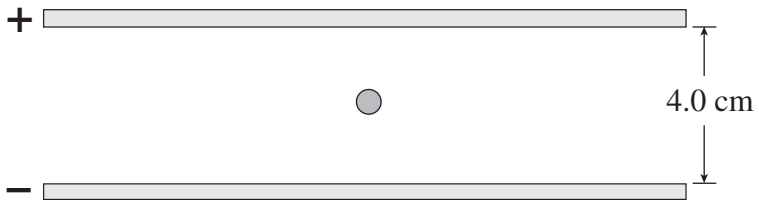
An 80 kg, 12 m uniform diving board in static equilibrium is shown below. Support A is providing a 3000 N force directed downward on the board.



Determine the force provided by support B and the distance ℓ.

3. **(6 marks)**

A small negatively charged sphere with a mass of 4.5×10^{-6} kg is suspended electrostatically between oppositely charged horizontal parallel plates as shown in the diagram. A potential difference of 360 V is required across the plates to hold the charged sphere stationary.

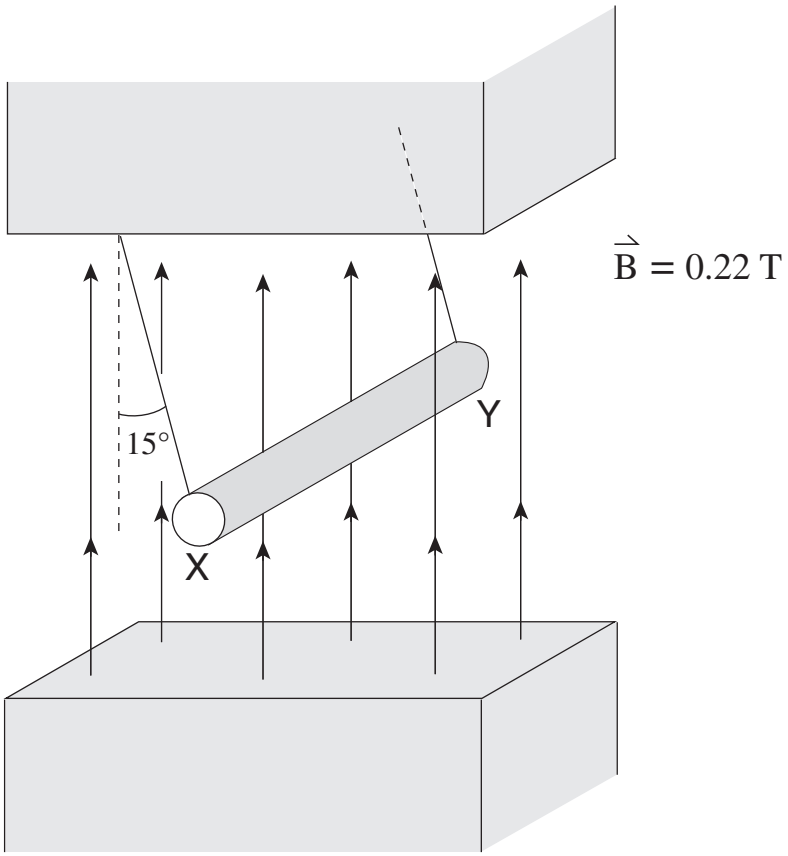


Calculate the magnitude of the charge on the sphere.

A sphere with a smaller mass carrying an equal but opposite charge is now placed between the plates. Using physics principles, explain the changes that must be made to the plates to keep the new sphere stationary.

4. **(5 marks)**

An 18 cm long metal rod, of mass 35 g, is suspended from the ceiling with light wire. A uniform 0.22 T magnetic field is directed vertically upward. When there is a current in the rod, it swings outward 15° to the vertical as shown.



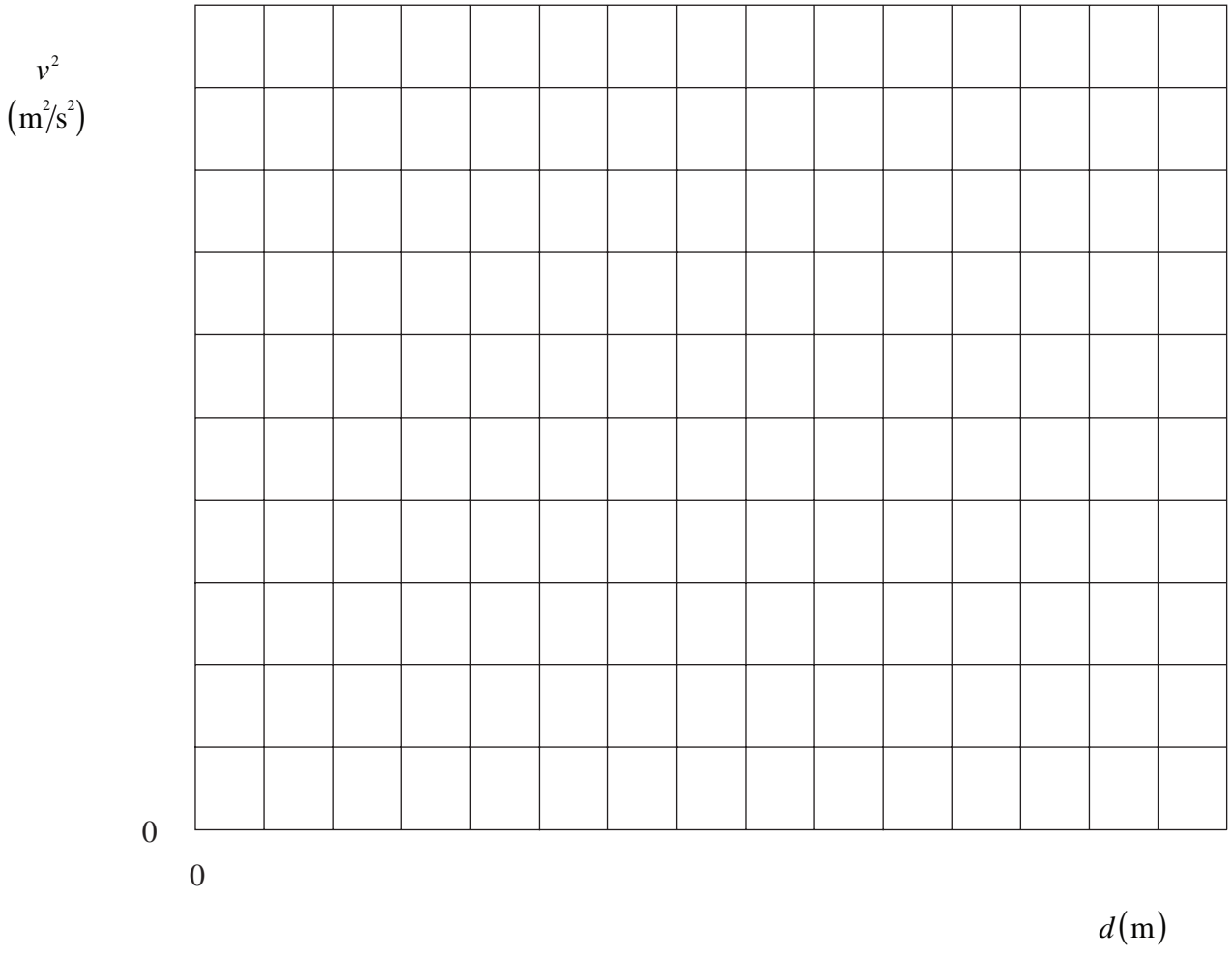
What are the magnitude and the direction of the current in the rod?

5. **(5 marks)**

A student measures the final speed of an accelerating car at various displacements. The data collected is shown below.

FINAL SPEED (m/s)	v^2	**DISPLACEMENT** (m)
5.9		2.0
6.5		4.0
7.2		6.0
7.9		8.0
8.4		10.0
9.0		12.0

Plot a graph of the final speed squared, v^2, versus the displacement, d, of the car on the graph below.



Determine the slope of the line of best fit to the data and state what the slope represents. Extend the line to the *y*-axis and use the *y*-intercept to determine the initial speed of the car.

6. **(4 marks)**

A motor and a light bulb are connected in series with a battery. Using principles of physics, explain why the light bulb gets brighter when the motor is prevented from spinning.

END OF EXAMINATION

Examination Rules

1. The time allotted for this examination is two hours.
   You may, however, take up to 60 minutes of additional time to finish.
2. Answers entered in the Examination Booklet will not be marked.
3. Cheating on an examination will result in a mark of zero. The Ministry of Education considers cheating to have occurred if students break any of the following rules:

   - Students must not be in possession of or have used any secure examination materials prior to the examination session.
   - Students must not communicate with other students during the examination.
   - Students must not give or receive assistance of any kind in answering an examination question during an examination, including allowing one's paper to be viewed by others or copying answers from another student's paper.
   - Students must not possess any book, paper or item that might assist in writing an examination, including a dictionary or piece of electronic equipment, that is not specifically authorized for the examination by ministry policy.
   - Students must not copy, plagiarize or present as one's own, work done by any other person.
   - Students must immediately follow the invigilator's order to stop writing at the end of the examination time and must not alter an Examination Booklet, Response Booklet or Answer Sheet after the invigilator has asked students to hand in examination papers.
   - Students must not remove any piece of the examination materials from the examination room, including work pages.

4. The use of inappropriate language or content may result in a mark of zero being awarded.
5. Upon completion of the examination, return all examination materials to the supervising invigilator.