BRITISH COLUMBIA
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Physics 12

Examination Booklet
2007/2008 Released Exam
January 2008

Form A

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

FOR FURTHER INSTRUCTIONS REFER TO THE RESPONSE BOOKLET.

Contents: 18 pages
35 multiple-choice questions in the Examination Booklet
6 written-response questions in the Response Booklet

Examination: 2 hours
Additional Time Permitted: 60 minutes

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.

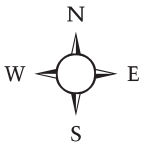
You have **Examination Booklet Form A**. In the box above #1 on your **Answer Sheet**, fill in the bubble as follows.

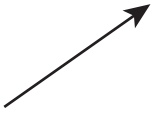
Exam Booklet Form/ Cahier d'examen	A	B	C	D	E	F	G	H
	●	○	○	○	○	○	○	○

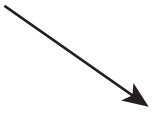
1. Which of the following is a vector quantity?

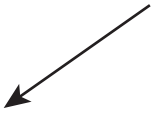
   A. magnetic field
   B. electric charge
   C. coefficient of friction
   D. permeability of free space

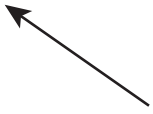
2. An aircraft is flying due west. Some time later it is flying due north. Which vector best represents the aircraft's change in velocity?



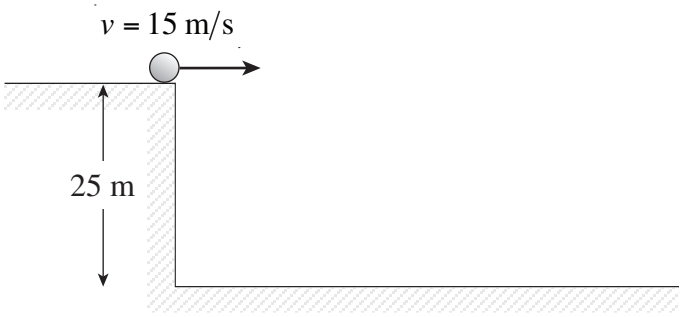
A. 

B. 

C. 

D. 

3. A projectile is launched horizontally from a cliff edge as shown.



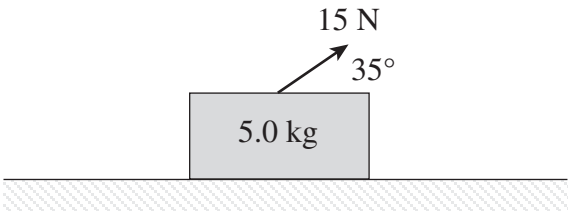
What is the projectile's vertical speed 2.0 s into the flight?

A. 15 m/s
B. 20 m/s
C. 30 m/s
D. 150 m/s

4. Which of the following has the same units as gravitational field strength?

A. 1/force
B. 1/mass
C. mass/force
D. force/mass

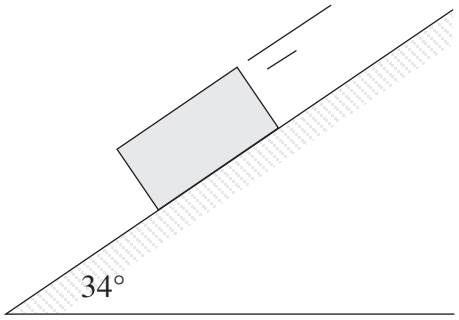
5. A 15 N force is applied to a 5.0 kg block as shown.



What is the normal force on the block?

A. 37 N
B. 40 N
C. 49 N
D. 58 N

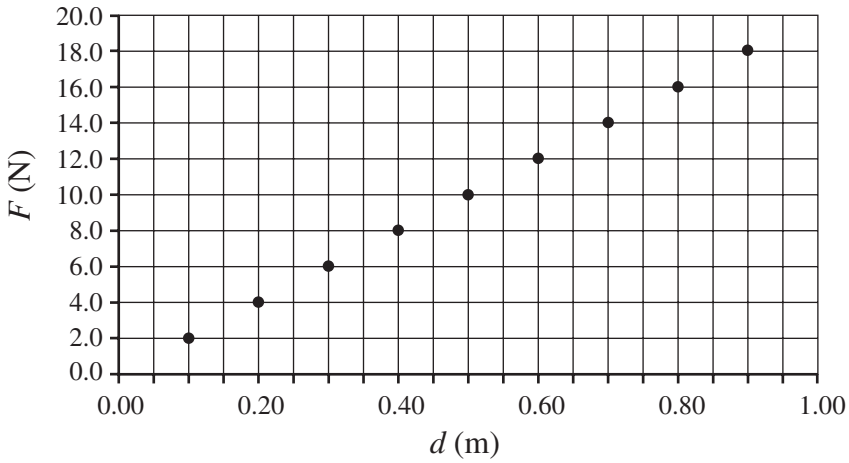
6. A 6.0 kg block is on an incline. The friction force acting on the block is 25 N.



What is the magnitude of the block's acceleration?

A. 1.3 m/s^2
B. 2.0 m/s^2
C. 4.0 m/s^2
D. 5.6 m/s^2

7. A varying force applied to an object is described by the *F* vs. *d* graph below.



What is the work done by this force as it moves the object from 0.20 to 0.80 m?

A. 0.80 J
B. 6.0 J
C. 7.2 J
D. 20 J

8. A 1500 kg plane, initially at rest, leaves an airfield and a short time later it is at an elevation of 3200 m travelling at $65\ \text{m/s}$. What is the minimum work done by the plane's engine in this time? (Ignore air resistance.)

A. 3.2×10^6 J
B. 4.4×10^7 J
C. 4.7×10^7 J
D. 5.0×10^7 J

9. A 0.25 kg ball moving north at $7.7\ \text{m/s}$ strikes a wall obliquely and rebounds heading east with the same speed of $7.7\ \text{m/s}$. What was the magnitude and direction of the impulse on the ball?

	MAGNITUDE OF THE IMPULSE	DIRECTION OF THE IMPULSE
A.	$1.9\ \text{N} \cdot \text{s}$	Due East
B.	$1.9\ \text{N} \cdot \text{s}$	45°S of E
C.	$2.7\ \text{N} \cdot \text{s}$	Due East
D.	$2.7\ \text{N} \cdot \text{s}$	45°S of E

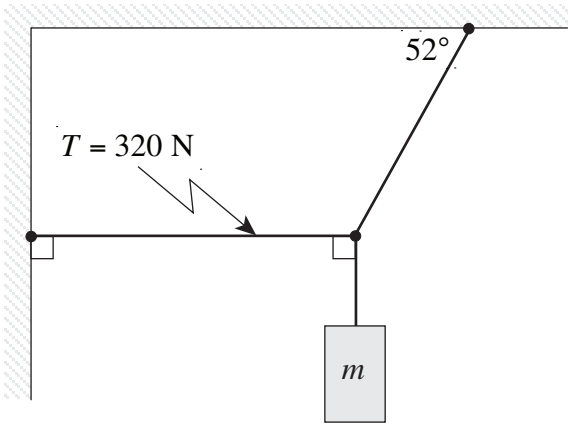
10. A 7.3×10^3 kg space vehicle and its empty 6.8×10^2 kg booster unit are moving together through space at $370\ \text{m/s}$. An explosion lasting 2.2 s is used to separate the two parts. If the speed of the space vehicle after the separation is increased to $430\ \text{m/s}$, what impulse acted on the booster unit?

A. $4.1 \times 10^4\ \text{N} \cdot \text{s}$
B. $2.0 \times 10^5\ \text{N} \cdot \text{s}$
C. $2.2 \times 10^5\ \text{N} \cdot \text{s}$
D. $4.4 \times 10^5\ \text{N} \cdot \text{s}$

11. A 1300 kg car moving east collided with a 2600 kg SUV moving north at 28 m/s. The vehicles became stuck together. If the speed of the vehicles immediately after the collision was 30 m/s, what was their direction?

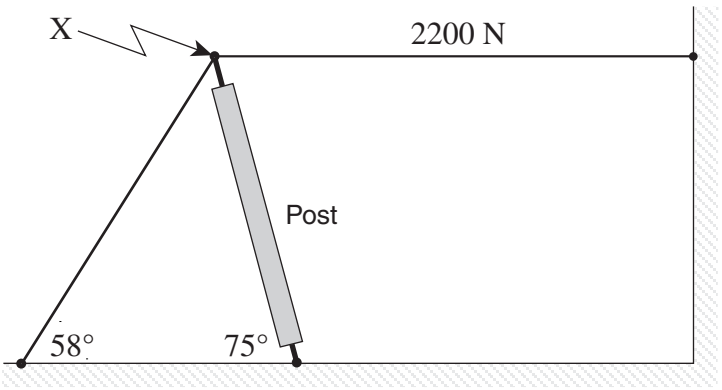
A. 21° E of N
B. 52° E of N
C. 58° E of N
D. 69° E of N

12. An object is supported by two cords as shown. The tension in the horizontal cord is 320 N. What is the mass *m*?



A. 26 kg
B. 42 kg
C. 53 kg
D. 250 kg

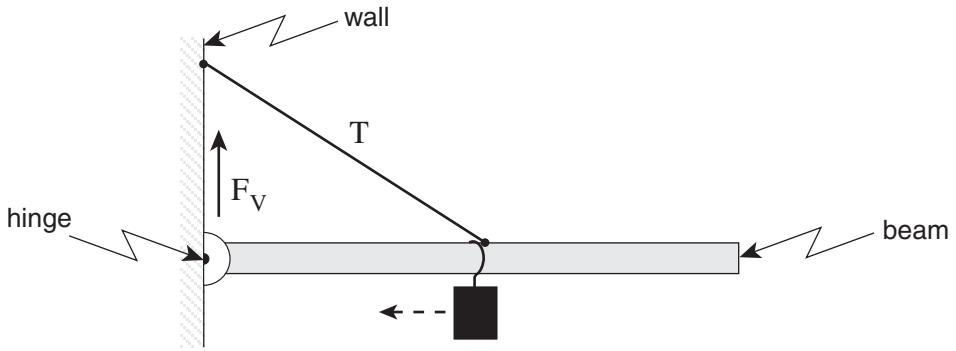
13. A post of negligible mass is supported by two cables as shown.



What is the force exerted by the post on point X?

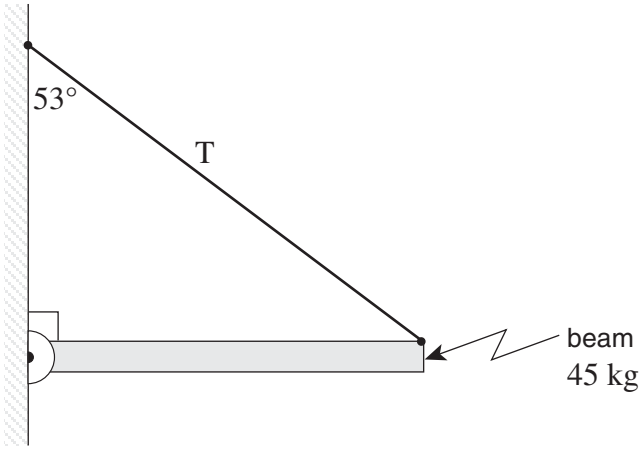
A. 1100 N
B. 2600 N
C. 2900 N
D. 5100 N

14. If the load on the uniform beam shown below is moved to the left, how do the tension force T and the magnitude of the vertical force F_V exerted by the wall on the hinge change?



	TENSION FORCE T	VERTICAL FORCE F_V
A.	Decrease	Increase
B.	Decrease	Decrease
C.	Increase	Increase
D.	Increase	Decrease

15. A uniform 45 kg beam of length 3.0 m is supported as shown.



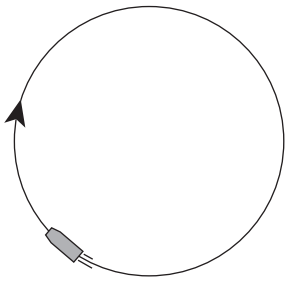
What is the tension T in the cable?

A. 220 N
B. 280 N
C. 290 N
D. 370 N

16. A car completes a horizontal circle of radius r in time T. The same car then completes a larger horizontal circle of radius $2r$ in twice the time, $2T$. What is the ratio of the centripetal acceleration a_c for the car in the second circle to that in the first circle a_{c2}/a_{c1} ?

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

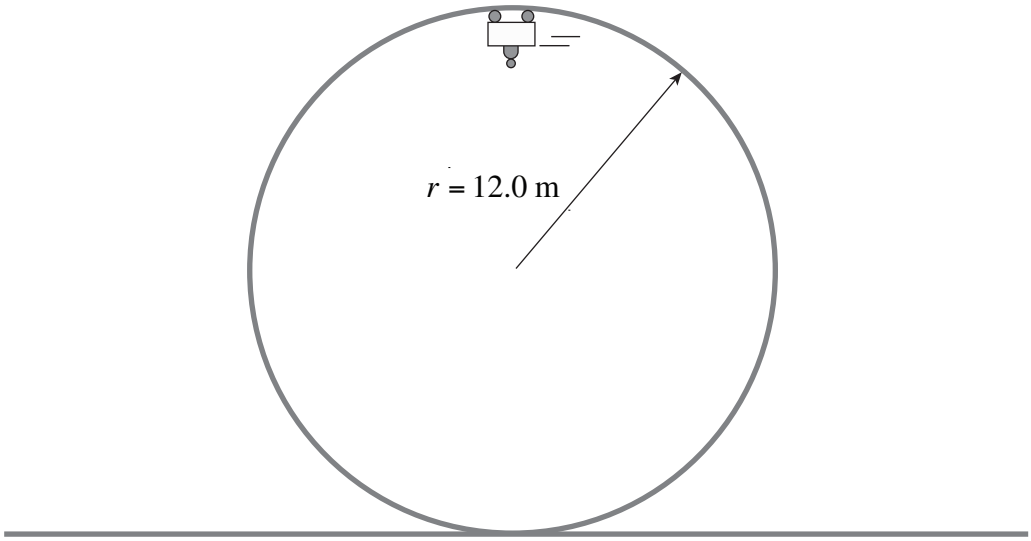
17. An object is in uniform horizontal circular motion.



Which of the following shows the correct direction for the velocity, centripetal acceleration, and centripetal force on the object at the point shown?

	DIRECTION OF THE VELOCITY	DIRECTION OF THE CENTRIPETAL ACCELERATION	DIRECTION OF THE CENTRIPETAL FORCE
A.	↖	↙	↗
B.	↗	↙	↙
C.	↖	↗	↗
D.	↗	↗	↙

18. A roller coaster car carrying a 75.0 kg man has a speed of 11.0 m/s at the top of a circular loop.



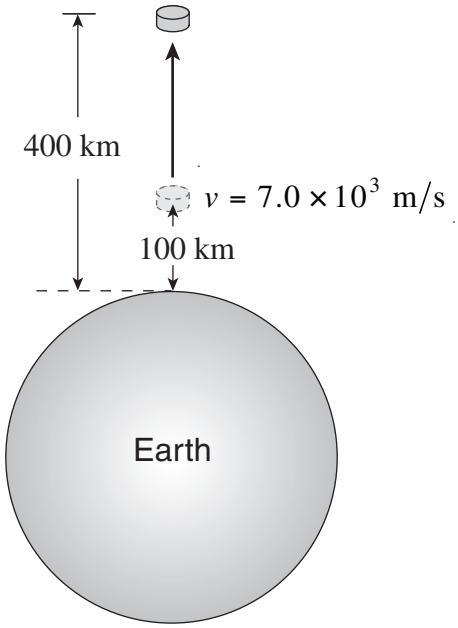
What is the normal force acting on the man at the top of the loop?

A. 0.0 N
B. 21 N
C. 735 N
D. 756 N

19. Objects dropped near the surface of the moon fall with one sixth the acceleration of objects dropped near the surface of the earth. Which of the following is the correct value for the gravitational field strength at the moon's surface?

A. 0.0027 N/kg
B. 0.27 N/kg
C. 1.6 N/kg
D. 9.8 N/kg

20. An unpowered 1600 kg object has an upward velocity of 7.0×10^3 m/s at an altitude of 100 km above the earth. The object reaches a maximum altitude of 400 km.



What is the heat energy generated during the object's increase in altitude from 100 km to 400 km?

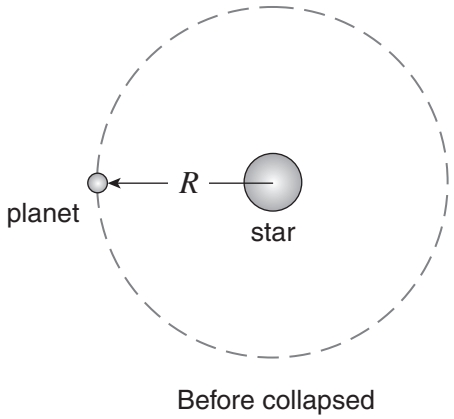
A. 3.3×10^{10} J

B. 3.4×10^{10} J

C. 3.5×10^{10} J

D. 5.5×10^{10} J

21. A planet is in an orbit of radius R around a star. The star collapses to $\frac{1}{10}$ of its original volume while maintaining all of its mass.



What happens to the centripetal acceleration, a_c, of the planet due to the collapse of the star?

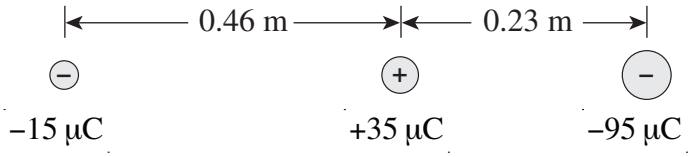
A. reduced to $\frac{1}{100}$ original a_c

B. reduced to $\frac{1}{10}$ original a_c

C. remains unchanged

D. increased to $10\times$ original a_c

22. Three point charges are arranged as shown below.



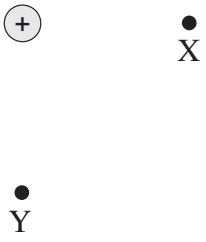
What are the magnitude and direction of the electric force on the $-15\ \mu C$ charge due to the other two point charges?

	MAGNITUDE OF ELECTRIC FORCE	DIRECTION OF ELECTRIC FORCE
A.	4.6 N	left
B.	4.6 N	right
C.	49 N	left
D.	49 N	right

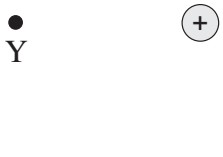
23. Each diagram shows two points X and Y in the electric field near a positive charge. In which case is the difference in the magnitudes of the electric field strengths for the two points greatest?

A.

B.



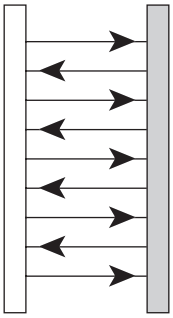
C.



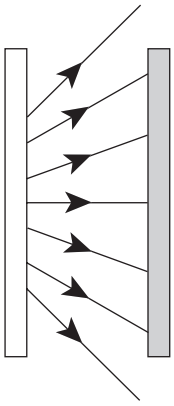
D.

24. Which of the following correctly shows the electric field between two oppositely charged plates?

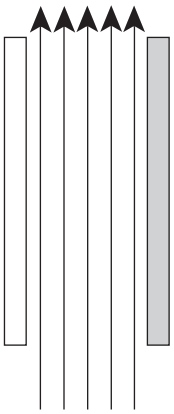
A.



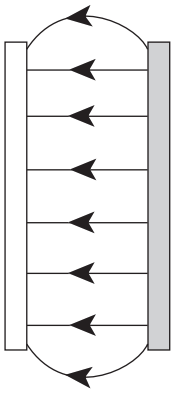
B.



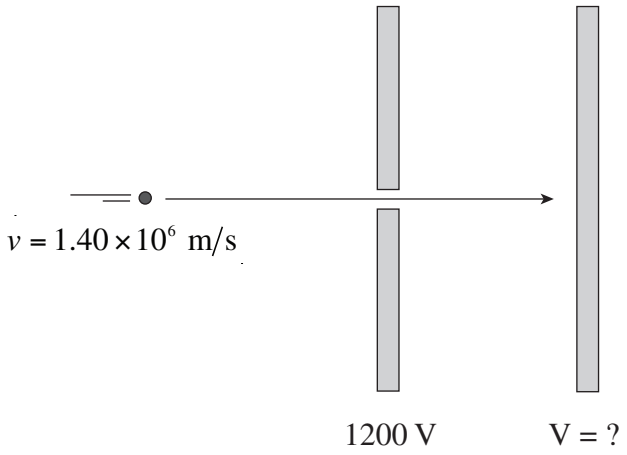
C.



D.



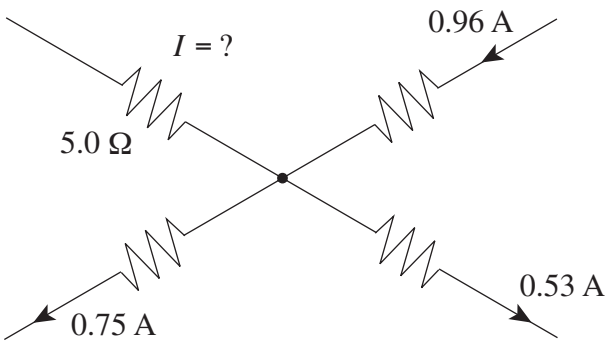
25. A proton travelling at 1.40×10^6 m/s enters the region between two charged parallel plates as shown.



What voltage applied to the second plate would result in the proton just reaching this plate $\left(v_f = 0 \text{ at second plate}\right)$ and what is the direction of the electric field between the plates?

	VOLTAGE APPLIED TO SECOND PLATE	DIRECTION OF E-FIELD
A.	9 030 V	right
B.	9 030 V	left
C.	11 400 V	right
D.	11 400 V	left

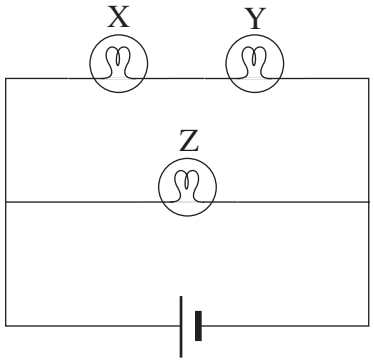
26. A circuit junction is shown below.



What is the current and its direction through the $5.0\ \Omega$ resistor?

	CURRENT	DIRECTION
A.	0.32 A	away from junction
B.	0.32 A	towards the junction
C.	2.24 A	away from junction
D.	2.24 A	towards the junction

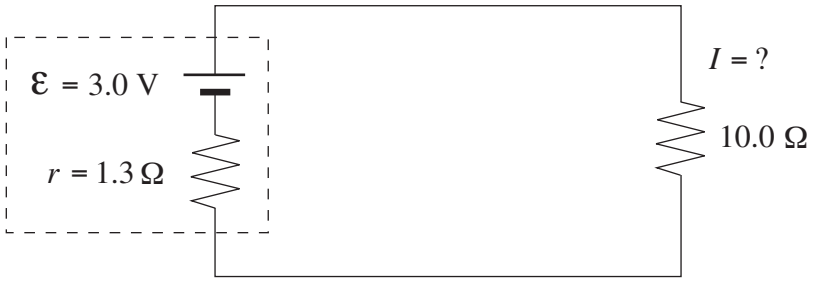
27. Three identical light bulbs are placed in a circuit as shown.



Which of the following is correct?

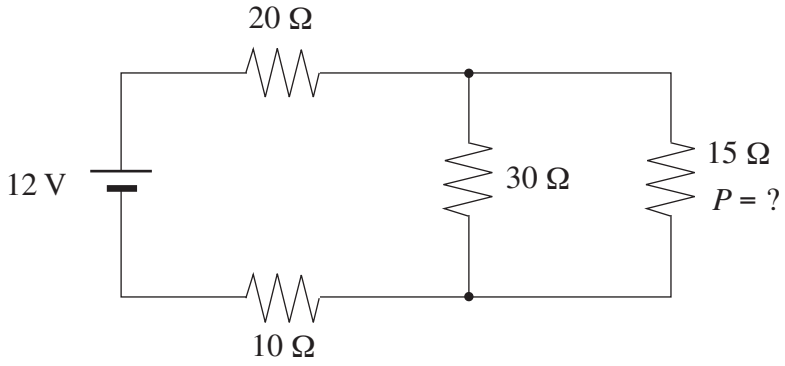
A. The voltage and current are the same for all three bulbs.
B. The current in light bulb Z is less than the current in light bulb X.
C. The current in light bulb Z is greater than the current in light bulb Y.
D. The voltage across light bulb Z is less than the voltage across light bulb X.

28. What is the current I through the $10.0\ \Omega$ resistor in the circuit shown below?



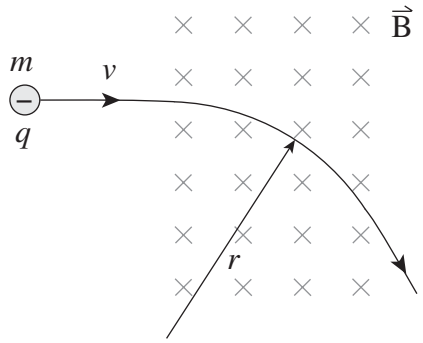
A. 0.27 A
B. 0.30 A
C. 0.34 A
D. 2.3 A

29. What power is dissipated by the $15\ \Omega$ resistor in the circuit shown?



A. 0.60 W
B. 1.4 W
C. 6.7 W
D. 15 W

30. A particle of mass m carrying a negative charge q passes through a perpendicular magnetic field B at speed v, as shown below. The radius of its circular path while it is within the magnetic field is r.



Which of the following is equal to the speed, v, of the particle?

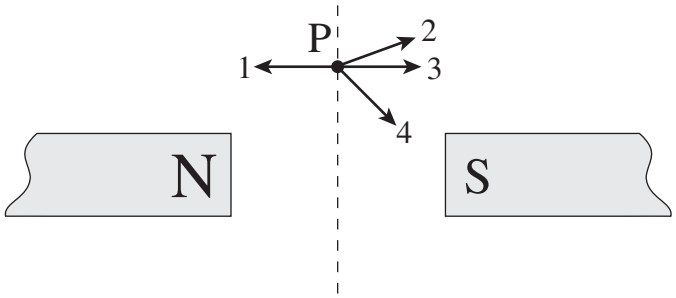
A. qr/mB

B. qBr/m

C. qB/rm

D. m/qBr

31. Two magnetic poles of unequal strength are placed as shown below.



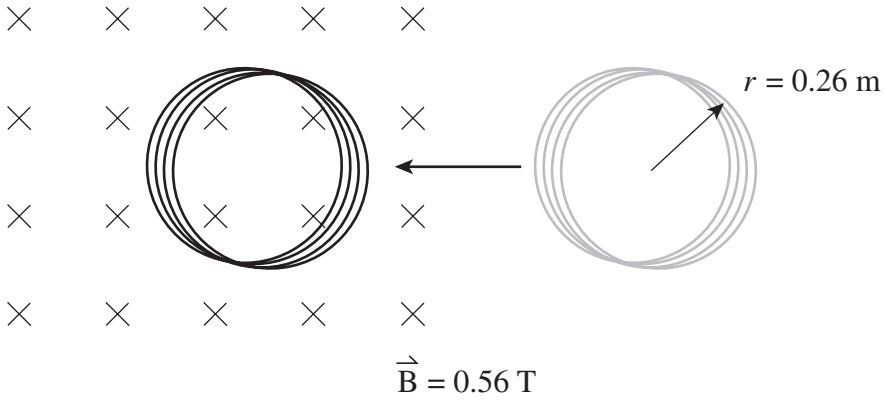
The north magnetic pole is stronger than the south magnetic pole. What is the direction of the magnetic field at point P on a line midway between the poles?

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

32. Which of the following is correct for the back emf of an electric motor operating at a constant speed?

A. The back emf is zero.
B. The back emf is increasing.
C. The back emf is decreasing.
D. The back emf remains constant.

33. A 520-turn circular coil of radius 0.26 m is initially outside a 0.56 T magnetic field. The coil is moved into the magnetic field, inducing an average emf of 47 V.



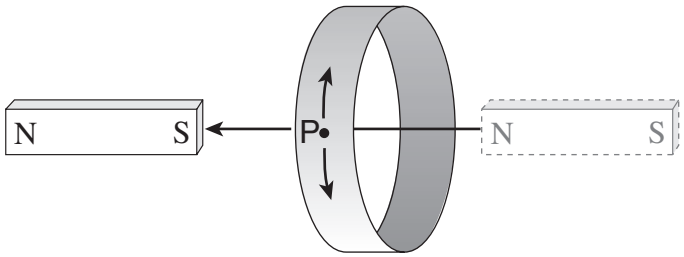
How much time does it take to move the coil to its new position?

A. 2.5×10^{-3} s
B. 1.3 s
C. 1.6 s
D. 2.6 s

34. A small transformer plugged into a 120 V outlet produces a voltage of 9.2 V and a current of 0.025 A to power a toy car. What is the ratio of **primary** windings to **secondary** windings in this transformer?

A. 1 to 13
B. 1 to 4800
C. 13 to 1
D. 4800 to 1

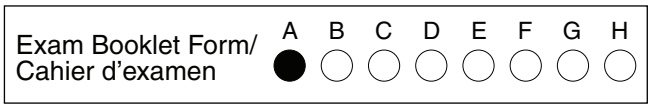
35. A magnet is passed through an aluminum ring as shown.



What is the direction of the induced current at point P on the ring as the north pole approaches the ring on the right side, and as the south pole leaves the ring on the left side?

	DIRECTION OF INDUCED CURRENT FOR NORTH POLE APPROACHING RING	DIRECTION OF INDUCED CURRENT FOR SOUTH POLE LEAVING RING
A.	Up	Up
B.	Down	Up
C.	Up	Down
D.	Down	Down

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



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

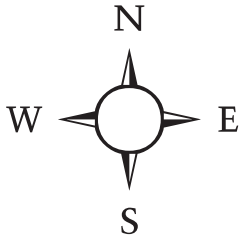
radius		$= 1.74 \times 10^{6}\ \text{m}$
mass		$= 7.35 \times 10^{22}\ \text{kg}$
period of rotation		$= 2.36 \times 10^{6}\ \text{s}$
radius of orbit around Earth		$= 3.84 \times 10^{8}\ \text{m}$
period of orbit around Earth		$= 2.36 \times 10^{6}\ \text{s}$

Sun

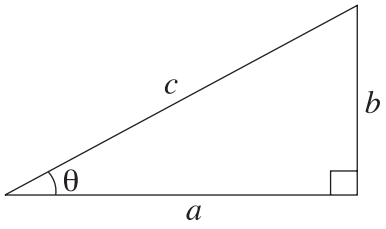
mass		$= 1.98 \times 10^{30}\ \text{kg}$

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:

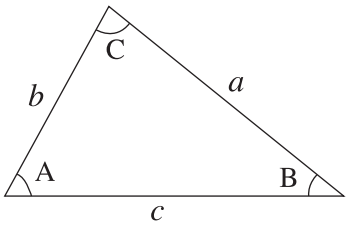


$$a^2 + b^2 = c^2$$

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

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

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:

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

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

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

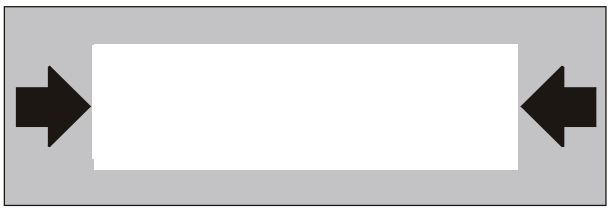
$$V_{\text{back}} = \mathcal{E} - Ir$$

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

ROUGH WORK FOR MULTIPLE-CHOICE

MINISTRY USE ONLY

Place Personal Education Number (PEN) here.



Course Code = PH 12

JANUARY 2008

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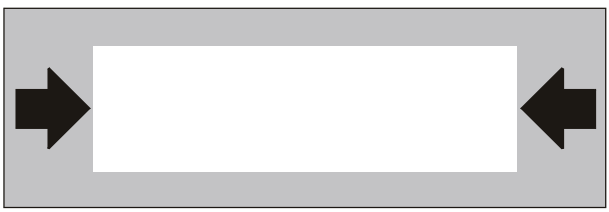
MINISTRY USE ONLY

Place Personal Education Number (PEN) here.



Course Code = PH 12

Physics 12

2007/2008 Released Exam

JANUARY 2008

Response Booklet

BRITISH COLUMBIA
The Best Place on Earth

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.

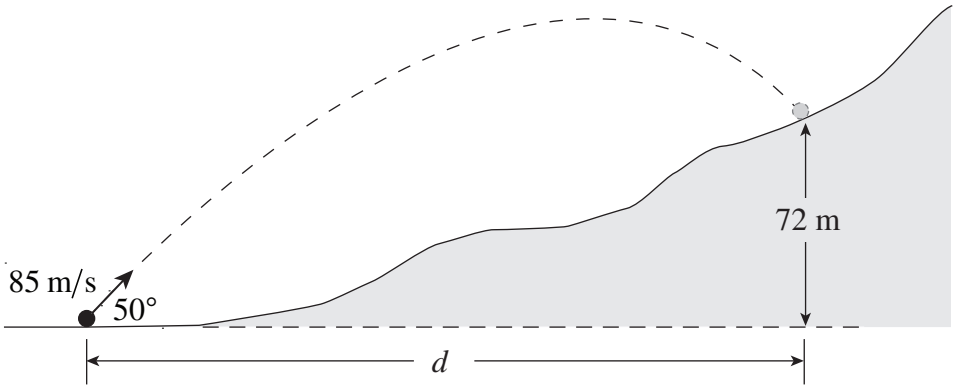
3. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution.

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)**

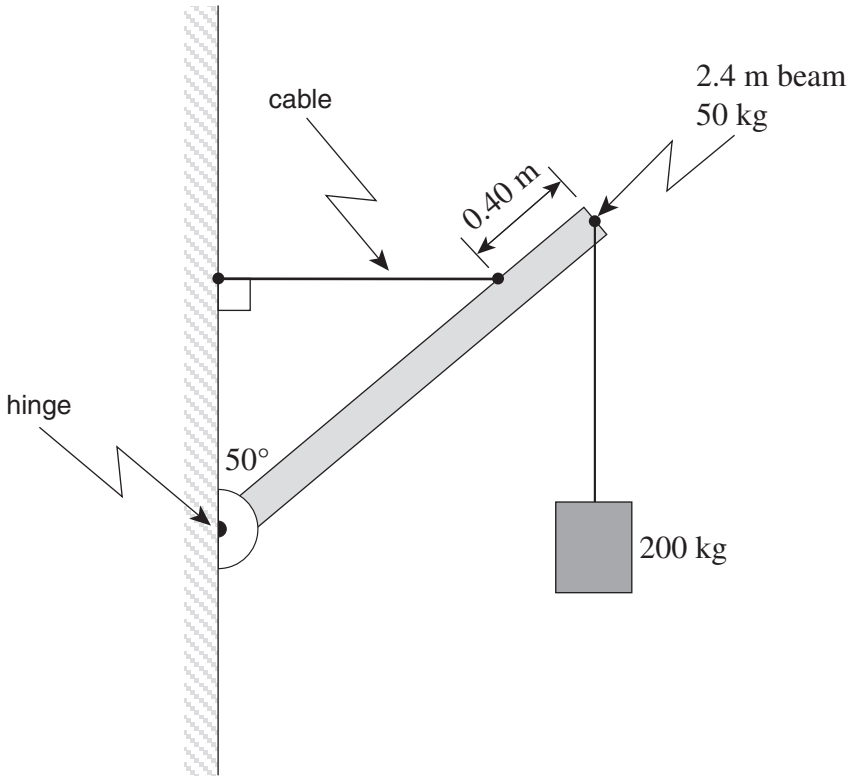
A cannon ball is launched at 85 m/s, 50° above the horizontal, towards a hill as shown.



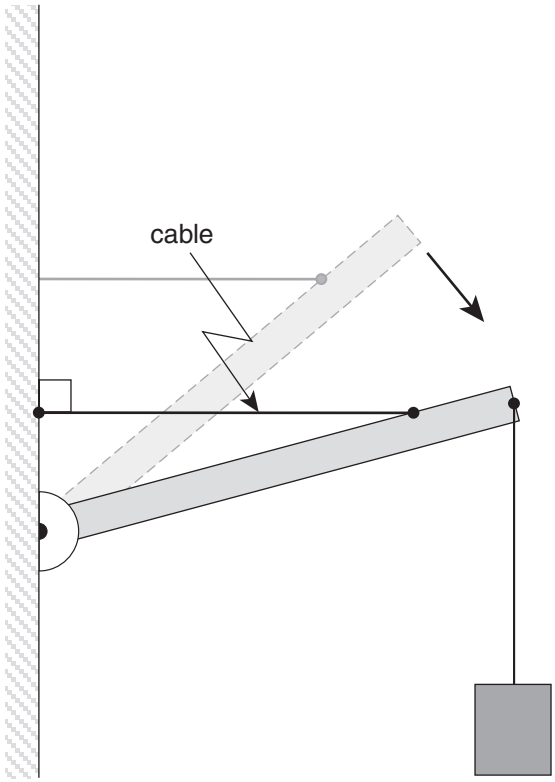
What horizontal distance *d* does the cannon ball travel before it impacts the hillside? (Ignore friction.)

2. **(6 marks)**

A uniform 50.0 kg beam with a length of 2.4 m supports a 200 kg load. What is the tension in the horizontal cable attached to the beam as shown below?

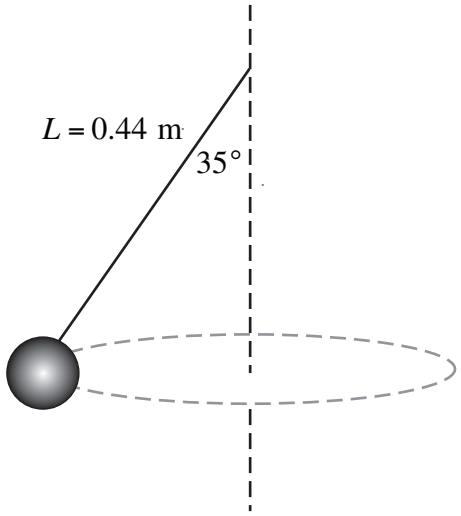


Using principles of physics, explain how this tension will change if the beam is lowered to a more horizontal orientation (i.e., greater angle) as shown below. The cable remains horizontal and connected to the same point on the beam.



3. **(5 marks)**

A blue ball is swung in a horizontal circle and completes a single rotation in 1.2 s. The 0.44 m long cord makes an angle of 35° with the vertical during the ball's motion as shown.



What is the centripetal acceleration of the ball?

4. **(5 marks)**

A proton enters a 0.65 T magnetic field. The velocity of the proton is perpendicular to the field causing the proton to travel in a circular arc of radius 1.1×10^{-2} m. What is the momentum of the proton?

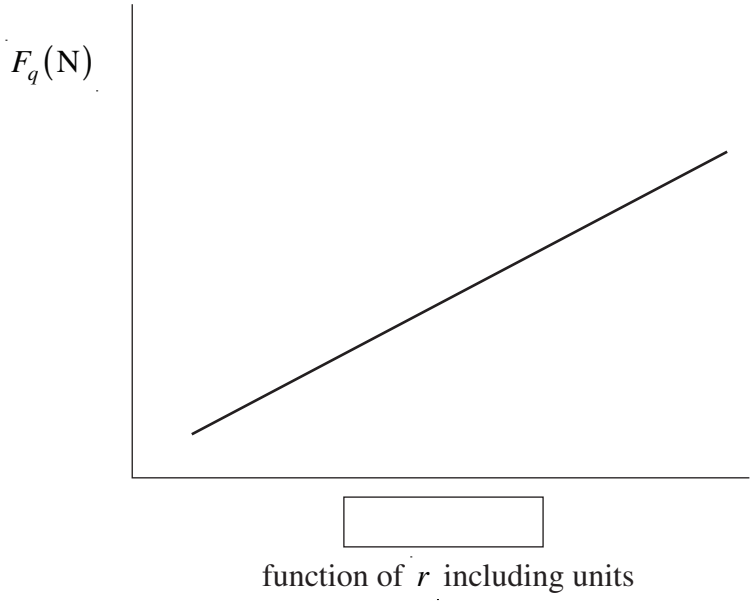
5. **(5 marks)**

During an electrostatics experiment to investigate Coulomb's Law, a positive point charge, q_1, is moved gradually closer to a $10\ \mu C$ charge that is fixed to a table top.

The electrostatic force, F_q, experienced by q_1 at several separation distances, r, from the $10\ \mu C$ fixed charge is recorded.

It is possible to use such data (F_q and r) to create a linear graph and obtain a slope.

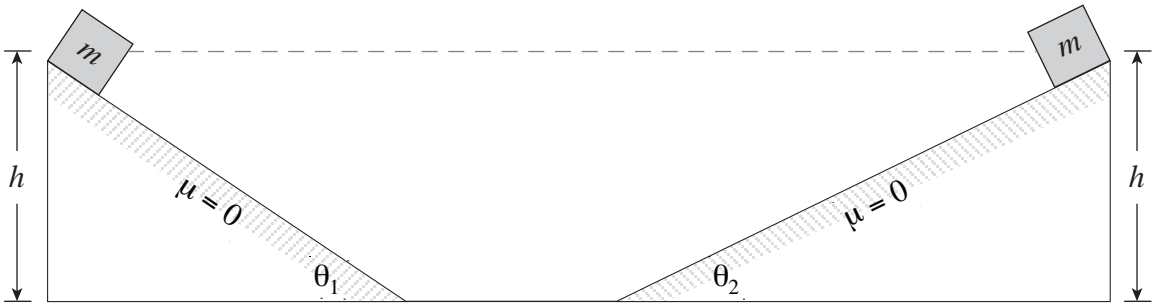
In the box on the graph below write the function (include units) of the separation distance, r, that must be used on the horizontal axis to produce a linear relation from this data.



Explain how you can use the slope of this graph to determine the unknown charge, q_1.

6. **(4 marks)**

The two bricks shown have equal mass and are initially positioned at the same height, h, above the floor, at rest. The surfaces of both inclined planes are frictionless.



Using principles of physics, explain why both masses have the same speed when they reach the floor.

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.