



Physics 12
Examination Booklet
August 2006
Form A

DO NOT OPEN ANY EXAMINATION MATERIALS UNTIL INSTRUCTED TO DO SO.
FOR FURTHER INSTRUCTIONS REFER TO THE RESPONSE BOOKLET.

PART A: MULTIPLE CHOICE

Value: 70 marks (2 marks per question)

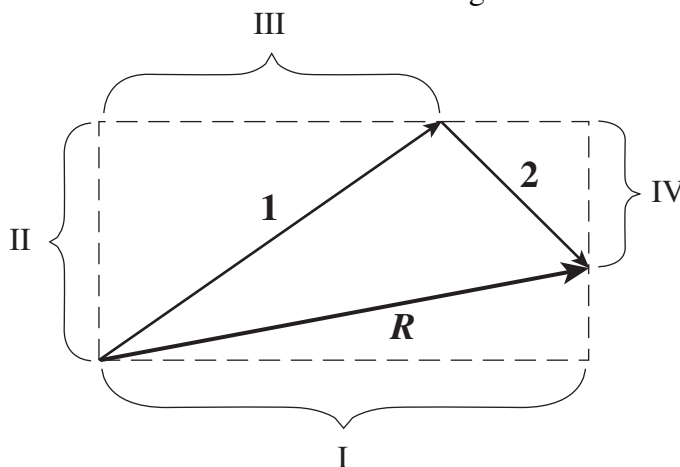
Suggested Time: 70 minutes

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
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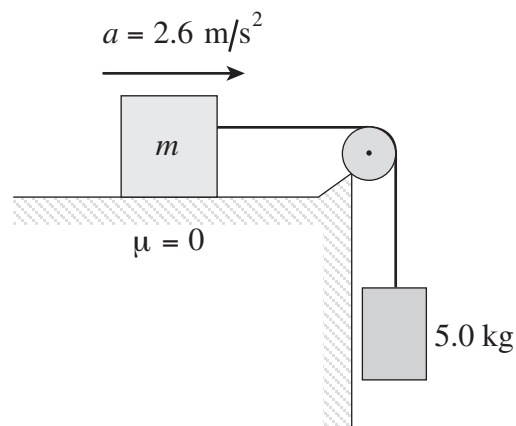
1. The diagram below shows the resultant vector R of adding vector 1 and vector 2 .



Which of the following represents the magnitude of the vertical component of vector 1 ?

- A. I
 - B. II
 - C. III
 - D. IV
2. A car accelerates from 30 m/s to 50 m/s in 1.4 s. How far does it travel during this time?
- A. 28 m
 - B. 42 m
 - C. 56 m
 - D. 70 m

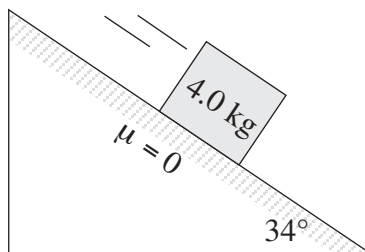
3. A red ball is launched over level ground with an initial velocity of 28 m/s , 40° above the horizontal. How long does it take to reach its maximum height above the ground?
- A. 1.8 s
 B. 2.2 s
 C. 2.4 s
 D. 2.9 s
4. A box of mass m is moving across a floor with an acceleration equal to a . Its velocity at any given instant is equal to v . Which of the following is equal to the net force acting on the box?
- A. m/a
 B. $m \cdot a$
 C. m/v
 D. $m \cdot v$
5. A block of mass m on a frictionless surface is attached to a hanging 5.0 kg mass as shown below. The system accelerates at 2.6 m/s^2 .



What is the mass of the block?

- A. 1.3 kg
 B. 14 kg
 C. 19 kg
 D. 24 kg

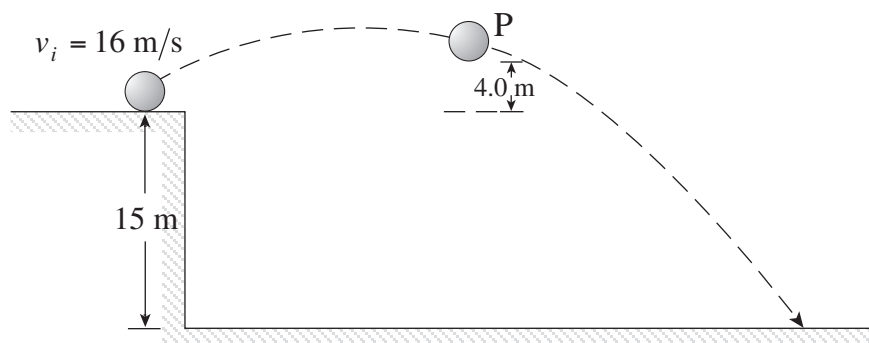
6. A 4.0 kg silver block is sliding down a frictionless inclined plane as shown below.



What is the block's acceleration?

- A. 2.5 m/s^2
- B. 5.5 m/s^2
- C. 6.6 m/s^2
- D. 8.1 m/s^2

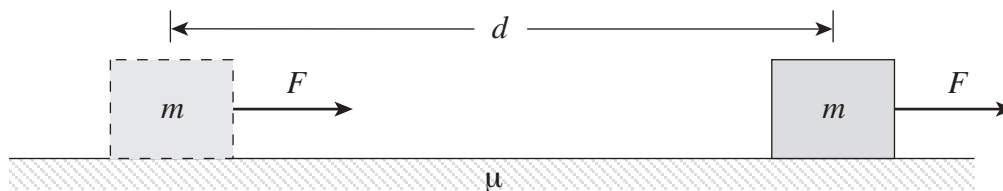
7. A 1.2 kg lead ball is launched off a cliff top at 16 m/s as shown below.



Determine the ball's kinetic energy (E_k) at position P. (Ignore friction.)

- A. 23 J
- B. 47 J
- C. $1.1 \times 10^2 \text{ J}$
- D. $1.3 \times 10^2 \text{ J}$

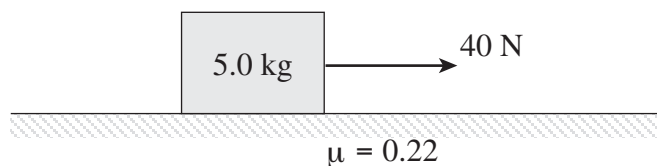
8. The force F shown below pulls a block of mass m from rest a distance d across a concrete floor. The coefficient of sliding friction between the floor and the block is μ .



What happens to the block's final kinetic energy and the amount of heat energy produced if μ is **increased**?

	FINAL KINETIC ENERGY	HEAT ENERGY
A.	increases	decreases
B.	decreases	increases
C.	increases	increases
D.	decreases	decreases

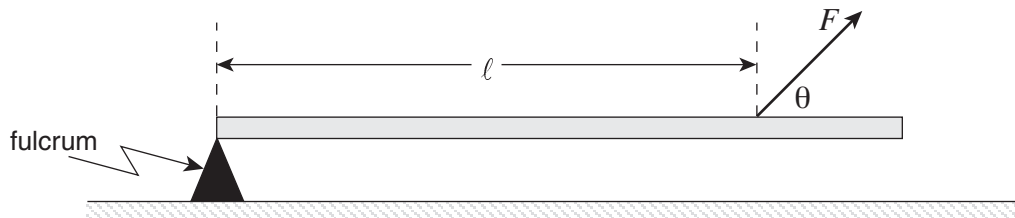
9. The 5.0 kg block shown below is accelerated from rest across a wood floor ($\mu = 0.22$) by a 40 N pulling force for 3.0 s.



What is the block's final momentum?

- A. 32 kg m/s
- B. 88 kg m/s
- C. 120 kg m/s
- D. 150 kg m/s

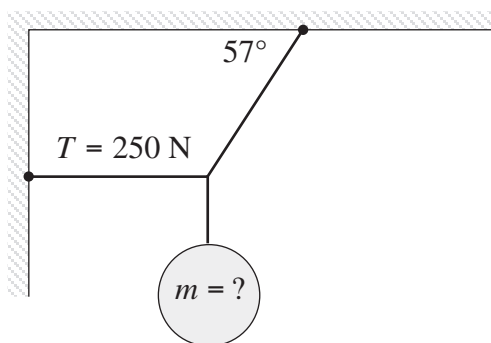
10. A 10 kg rock is at rest when a boulder of unknown mass collides with it. After the collision the 10 kg rock travels at 3.0 m/s south. What is the boulder's change in momentum due to the collision?
- 15 kg m/s south
 - 15 kg m/s north
 - 30 kg m/s south
 - 30 kg m/s north
11. A 1.5 kg physics block is sliding at 8.0 m/s north when it is hit by a 0.40 kg ball of putty going 20 m/s west. The putty sticks to the block. What is the magnitude of their combined momentum after the collision?
- 4.0 kg m/s
 - 8.9 kg m/s
 - 14 kg m/s
 - 20 kg m/s
12. A force is used to apply a torque to a beam as shown.



Which of the following is a correct equation for finding the torque about the fulcrum due to this force?

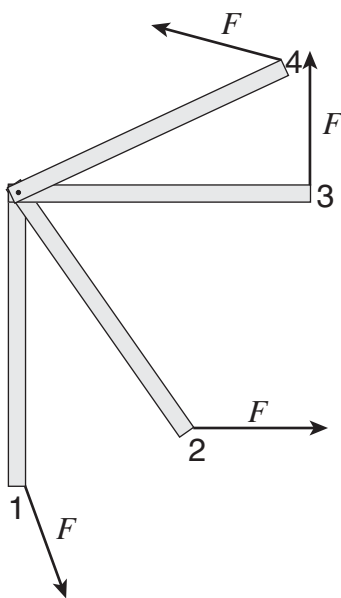
- $\tau = F \times \ell$
- $\tau = F/\ell$
- $\tau = F \times \cos\theta \times \ell$
- $\tau = F \times \sin\theta \times \ell$

13. A mass is suspended by two ropes from a ceiling and a wall.



Determine the mass m .

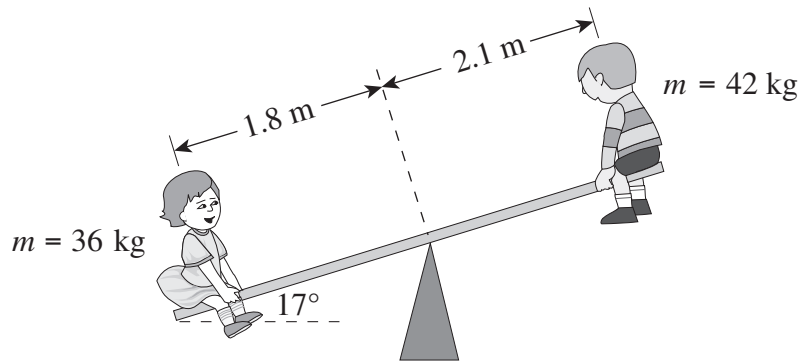
- A. 13 kg
 - B. 17 kg
 - C. 26 kg
 - D. 39 kg
14. A force is used to rotate a beam. As the beam rotates, the direction of the force changes but its magnitude does not.



What happens to the torque on the beam due to this force as the beam is rotated from position 1 to position 4?

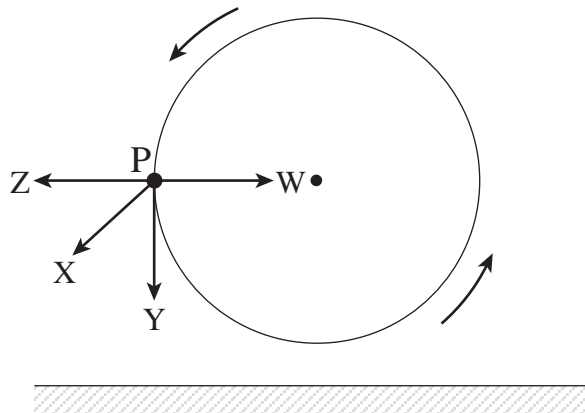
- A. always increases
- B. always decreases
- C. increases then decreases
- D. decreases then increases

15. Two young children are playing on a seesaw.



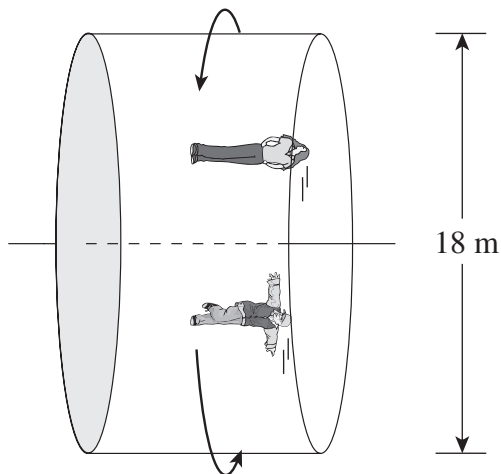
What is the magnitude of the net torque, due to the two children, about the seesaw pivot in the position shown?

- A. 220 Nm
 - B. 230 Nm
 - C. 1400 Nm
 - D. 1500 Nm
16. An object moves in uniform circular motion in a vertical plane. Which is the direction of the acceleration at P?



- A. W
 - B. X
 - C. Y
 - D. Z
17. A 1600 kg car moves at a constant speed of 28 m/s around a level 100 m radius circular track. What is the minimum coefficient of friction between the tires and the road surface?
- A. 0.18
 - B. 0.57
 - C. 0.80
 - D. 1.25

18. In an amusement park ride, riders are inside an 18 m diameter rotating cylinder.

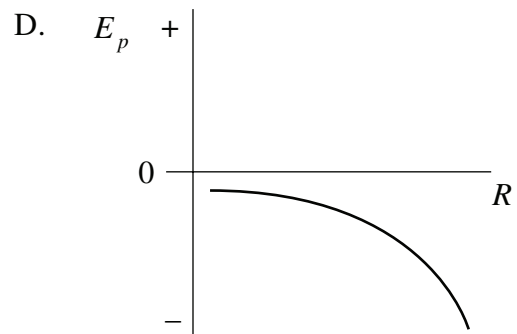
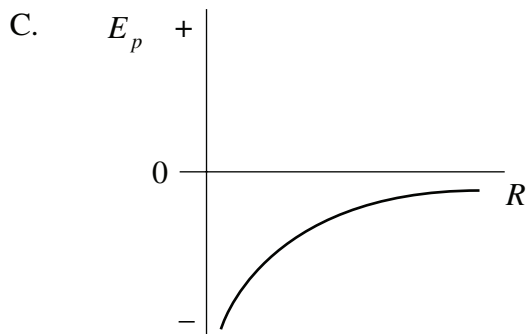
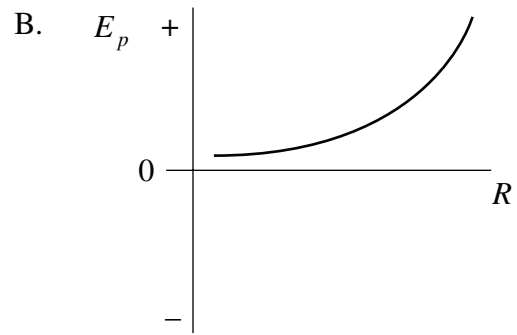
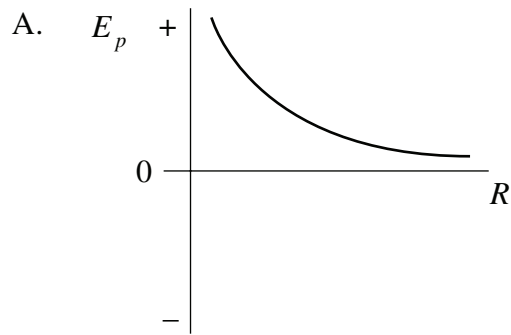


If the cylinder rotates once every 5.4 s, what force does the wall exert on a 58 kg rider at the top and bottom of the ride?

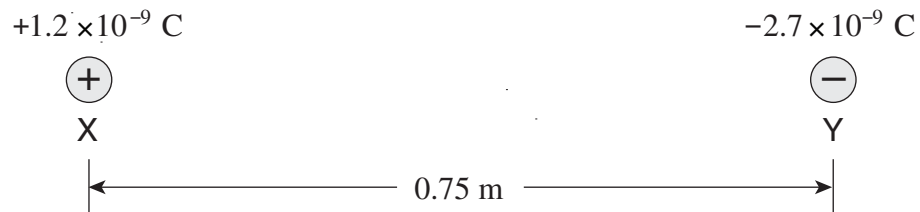
	TOP	BOTTOM
A.	140 N	140 N
B.	140 N	1300 N
C.	570 N	710 N
D.	710 N	710 N

19. Matter is orbiting around a collapsed star of mass 3.6×10^{30} kg at an orbital radius of 8.5×10^4 m. What is the orbital period of this matter?
- A. 1.2×10^{-7} s
 B. 1.0×10^{-4} s
 C. 1.0×10^{-2} s
 D. 1.0×10^1 s
20. A 4.5×10^4 kg vehicle is orbiting the earth with an orbital radius of 9.38×10^6 m and a speed of 6.52×10^3 m/s. What minimum energy is needed for this vehicle to reach a position infinitely far from the earth?
- A. 9.6×10^{11} J
 B. 1.9×10^{12} J
 C. 2.9×10^{12} J
 D. 4.1×10^{12} J

21. Which of the following graphs shows how the gravitational potential energy of an object varies with its distance from the earth?

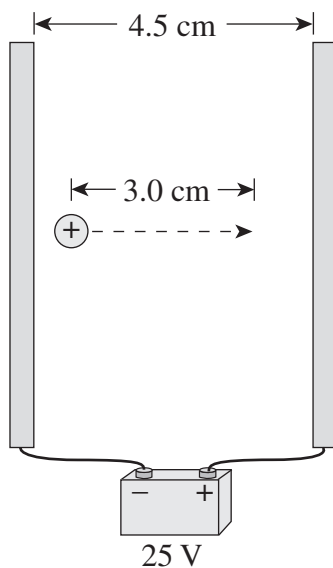


22. What are the magnitude and direction of the electric force on charge Y due to charge X?



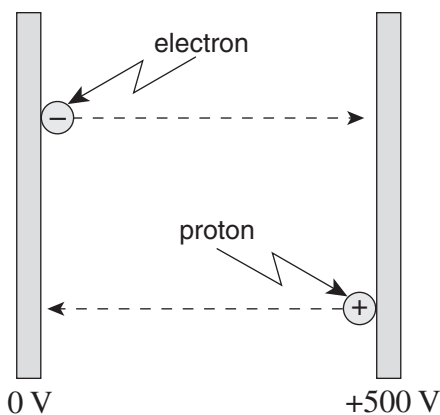
	MAGNITUDE	DIRECTION
A.	$3.9 \times 10^{-8} \text{ N}$	left
B.	$3.9 \times 10^{-8} \text{ N}$	right
C.	$5.2 \times 10^{-8} \text{ N}$	left
D.	$5.2 \times 10^{-8} \text{ N}$	right

23. A proton is moved 3.0 cm in the electric field between parallel plates. (Diagram not to scale.)



How much work was done on the proton?

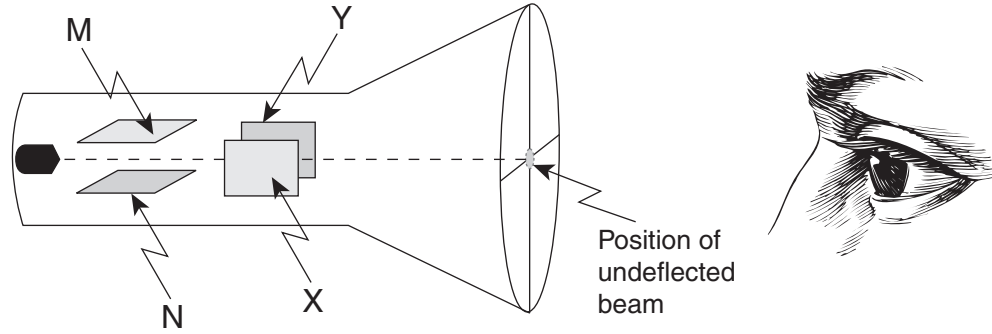
- A. 1.2×10^{-19} J
 - B. 2.7×10^{-18} J
 - C. 4.0×10^{-18} J
 - D. 6.0×10^{-18} J
24. A proton and an electron, initially at rest as shown, are accelerated across parallel plates.



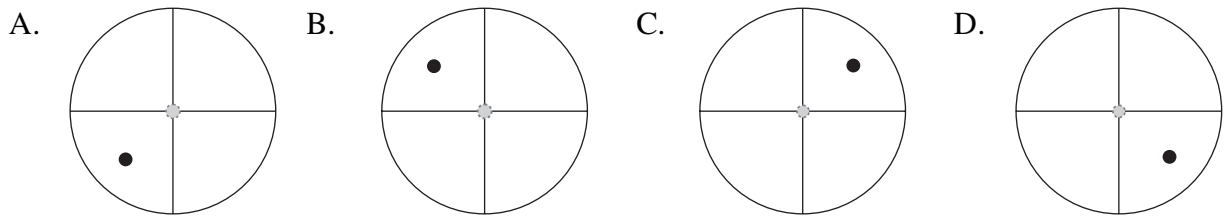
Which of the following best describes the final kinetic energies and speeds of the two particles?

	FINAL KINETIC ENERGY	FINAL SPEED
A.	same	same
B.	same	different
C.	different	same
D.	different	different

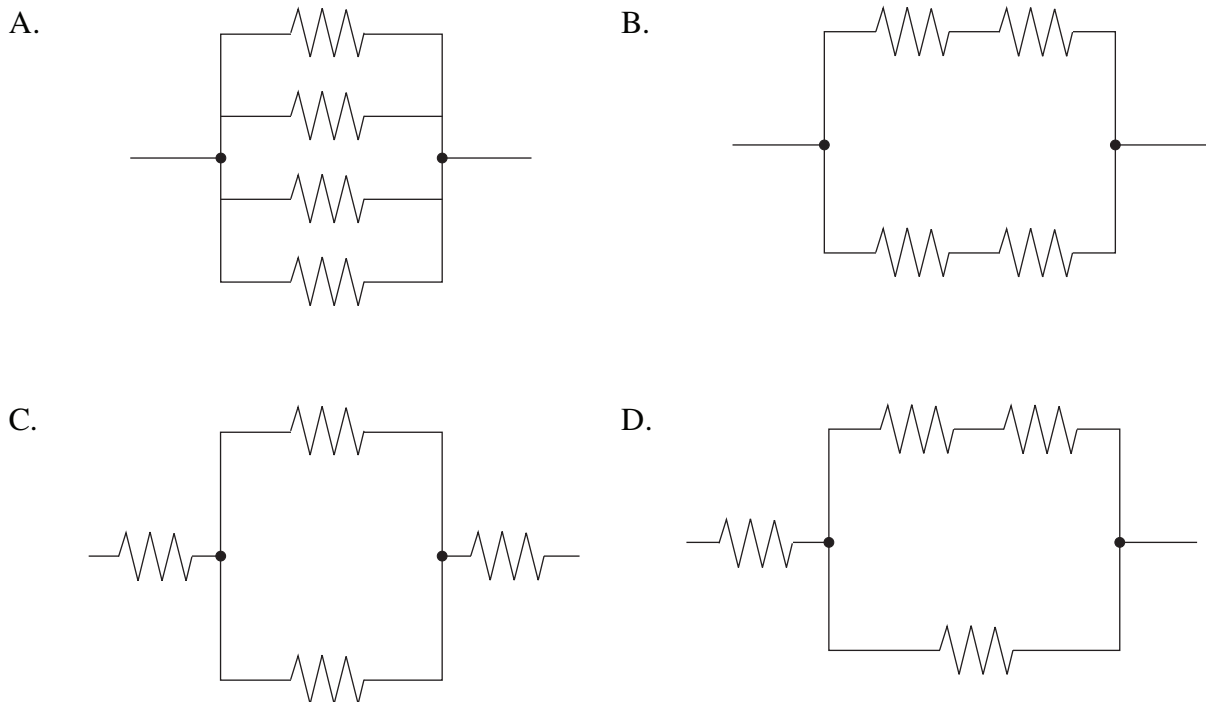
25. In the cathode ray tube shown, plates M and X are charged positively.



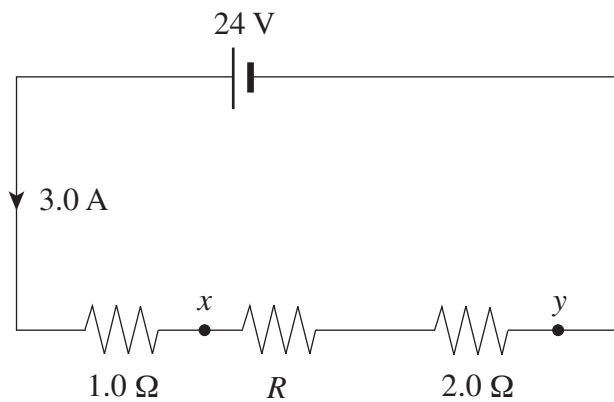
Which of the following shows the resulting position of the beam as seen on the screen?



26. Which arrangement of four identical resistors has the highest equivalent resistance?

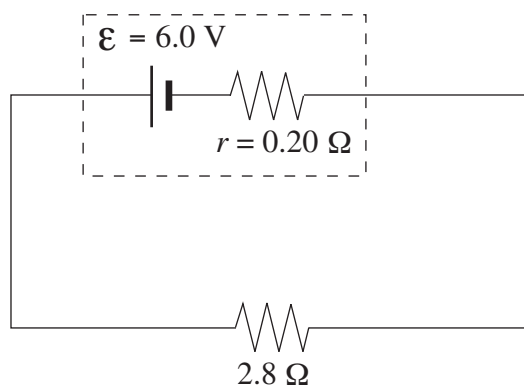


27. A series circuit consists of a battery and three resistors arranged as shown in the diagram below.



What is the potential difference V_{xy} ?

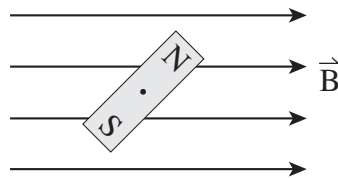
- A. 3.0 V
 - B. 6.0 V
 - C. 9.0 V
 - D. 21 V
28. What is the battery's terminal voltage in the circuit below?



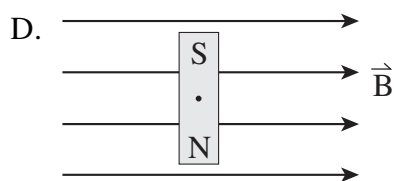
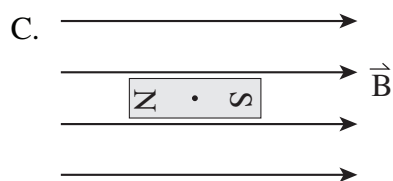
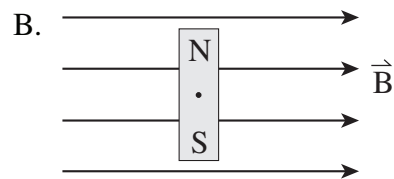
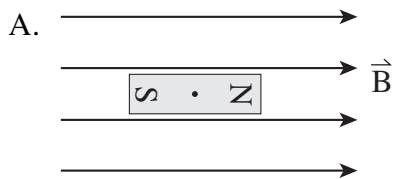
- A. 0.40 V
- B. 5.6 V
- C. 6.0 V
- D. 6.4 V

29. A student is instructed to determine the amount of charge flowing past a point in a circuit of unknown resistance during an experiment. What equipment will permit the student to do this?
- voltmeter
 - ammeter, voltmeter
 - ammeter, stopwatch
 - voltmeter, stopwatch

30. A bar magnet is free to rotate while in a magnetic field. It is initially positioned as shown.

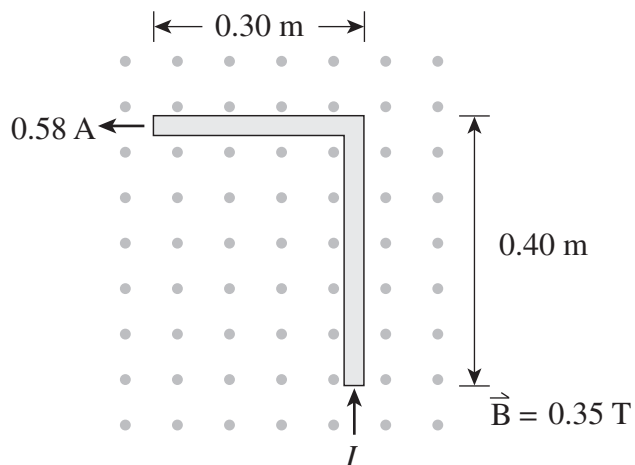


Which diagram shows the final orientation of the bar magnet?



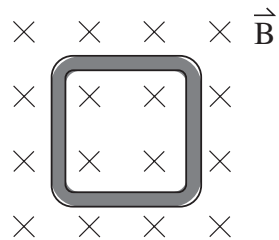
31. A charged particle travels in a circular path of radius R while in a uniform magnetic field. Which change reduces the radius to $\frac{1}{2}R$?
- halve the charge
 - double the mass
 - double the speed
 - double the magnetic field strength

32. What is the magnitude of the force due to a current of 0.58 A, on the L-shaped conductor in a 0.35 T field?

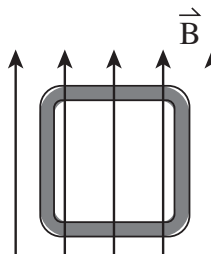


- A. 6.1×10^{-2} N
 B. 8.1×10^{-2} N
 C. 1.0×10^{-1} N
 D. 1.4×10^{-1} N
33. Which of the following single loops has the largest magnetic flux?

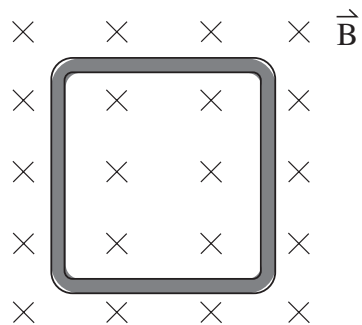
A.



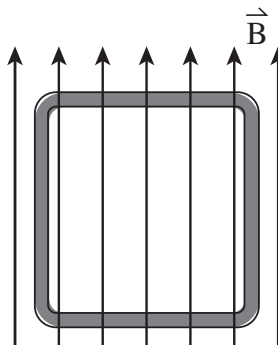
B.



C.



D.



34. A single loop of wire encloses an area of $3.5 \times 10^{-2} \text{ m}^2$. It is in a magnetic field that changes from $+0.72 \text{ T}$ to -0.25 T in a time of 0.060 s .



What is the induced emf and the direction of current flow in the loop?

	INDUCED EMF	DIRECTION OF CURRENT FLOW
A.	$2.7 \times 10^{-1} \text{ V}$	counter-clockwise
B.	$2.7 \times 10^{-1} \text{ V}$	clockwise
C.	$5.7 \times 10^{-1} \text{ V}$	counter-clockwise
D.	$5.7 \times 10^{-1} \text{ V}$	clockwise

35. An AC transformer converts 120 V into 3.0 V . A small electronic device draws $4.5 \times 10^{-3} \text{ A}$ from this transformer. If the secondary has 50 turns, what is the number of turns and current in the primary coil?

	PRIMARY COIL	
	NUMBER OF TURNS	CURRENT (A)
A.	2.0×10^3	$1.1 \times 10^{-4} \text{ A}$
B.	2.0×10^3	18 A
C.	40	$1.1 \times 10^{-4} \text{ A}$
D.	40	18 A

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
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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	$\mu_0 = 4\pi \times 10^{-7} \text{ T} \cdot \text{m}/\text{A}$
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

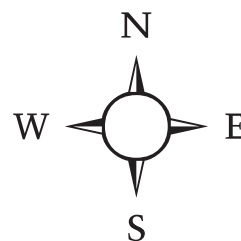
radius	$= 1.74 \times 10^6 \text{ m}$
mass	$= 7.35 \times 10^{22} \text{ kg}$
period of rotation.....	$= 2.36 \times 10^6 \text{ s}$
radius of orbit around Earth.....	$= 3.84 \times 10^8 \text{ m}$
period of orbit around Earth.....	$= 2.36 \times 10^6 \text{ s}$

Sun

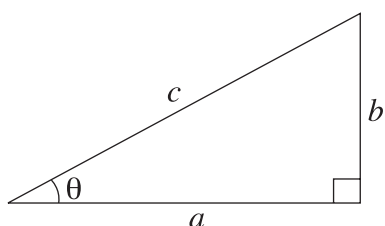
mass	$= 1.98 \times 10^{30} \text{ kg}$
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MATHEMATICAL FORMULAE

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:

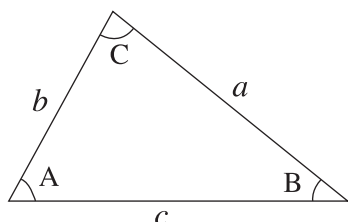


$$a^2 + b^2 = c^2$$

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

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

For All Triangles:



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

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

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

Circle:

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

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

Quadratic Equation:

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

PHYSICS FORMULAE

Vector Kinematics in Two Dimensions:

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

Vector Dynamics:

$$F_{\text{net}} = ma \quad F_g = mg$$
$$F_{\text{fr}} = \mu F_N$$

Work, Energy, and Power:

$$W = Fd \quad E_p = mgh$$
$$E_k = \frac{1}{2}mv^2 \quad P = \frac{W}{\Delta t}$$

Momentum:

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

Equilibrium:

$$\tau = Fd$$

Circular Motion:

$$T = \frac{1}{f}$$
$$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

Gravitation:

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

Electrostatics:

$$F = k \frac{Q_1 Q_2}{r^2} \quad E = \frac{F}{Q} \quad E = \frac{kQ}{r^2}$$
$$\Delta V = \frac{\Delta E_p}{Q} \quad E = \frac{\Delta V}{d}$$
$$E_p = k \frac{Q_1 Q_2}{r} \quad V = \frac{kQ}{r}$$

Electric Circuits:

$$I = \frac{Q}{\Delta t} \quad V = IR$$
$$V_{\text{terminal}} = \mathcal{E} \pm Ir \quad P = VI$$

Electromagnetism:

$$F = BIl \quad F = QvB$$
$$B = \mu_0 nI = \mu_0 \frac{N}{l} I \quad \mathcal{E} = Blv$$
$$\Phi = BA \quad \mathcal{E} = -N \frac{\Delta \Phi}{\Delta t}$$
$$V_{\text{back}} = \mathcal{E} - Ir$$
$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$$

ROUGH WORK FOR MULTIPLE-CHOICE

Place Personal Education Number (PEN) here.

➔

➔

Course Code = PH 12
AUGUST 2006

Exam Booklet Form/ Cahier d'examen

ABCDEFGH

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.

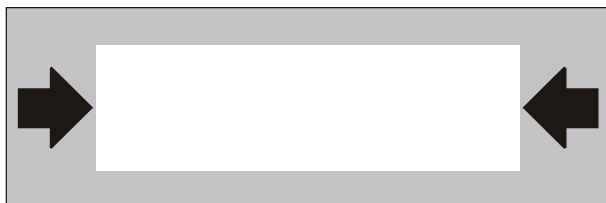
Question 1									
0	1	2	3	4	5	(.5) NR			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Question 2									
0	1	2	3	4	5	(.5) NR			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Question 3									
0	1	2	3	4	5	6	(.5) NR		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Question 4									
0	1	2	3	4	5	(.5) NR			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Question 5									
0	1	2	3	4	5	(.5) NR			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Question 6									
0	1	2	3	4	(.5) NR				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



MINISTRY USE ONLY



Place Personal Education Number (PEN) here.



Course Code = PH 12

Physics 12

AUGUST 2006

Response Booklet

PART B: WRITTEN RESPONSE

Value: 30 marks

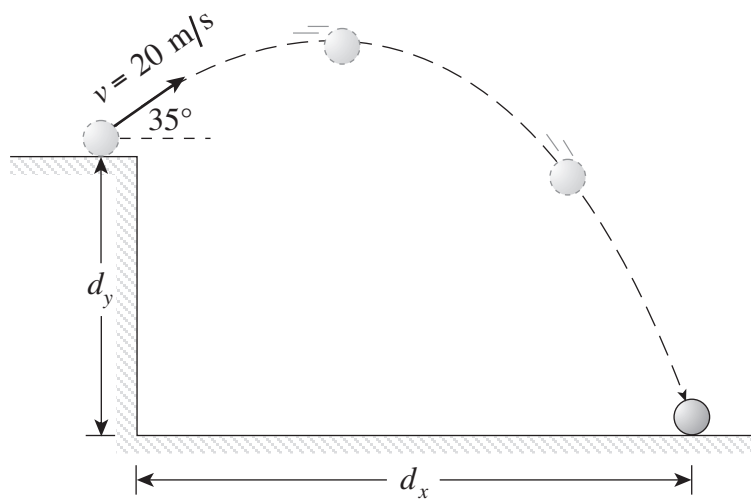
Suggested Time: 50 minutes

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)

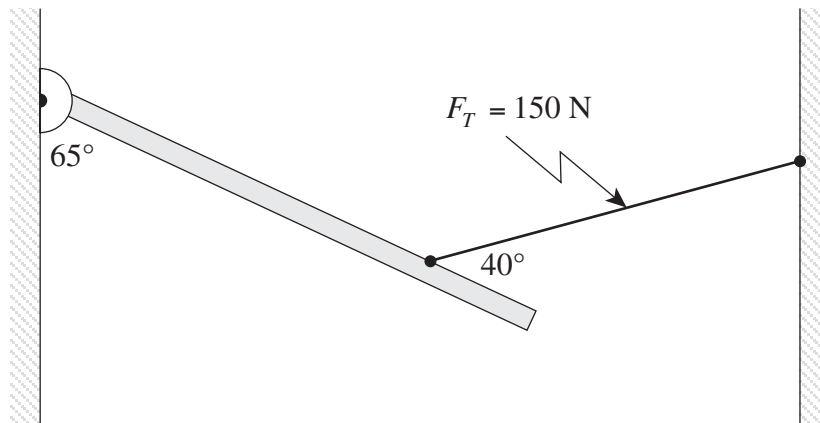
A projectile is launched from a cliff top at 20 m/s , 35° above the horizontal as shown below. The projectile hits the ground 3.7 s after it is launched.



Determine the height of the cliff (d_y) and the range (d_x) of the projectile.

2. (5 marks)

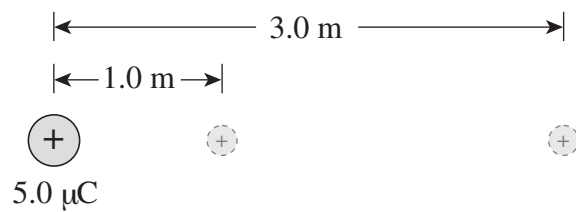
A 4.0 m long steel beam is supported 3.0 m from a hinge by a cable attached as shown.



If the tension in the cable is 150 N what is the mass of the steel beam?

3. (6 marks)

A proton at rest 1.0 m from a fixed $5.0 \mu\text{C}$ charge is released as illustrated.

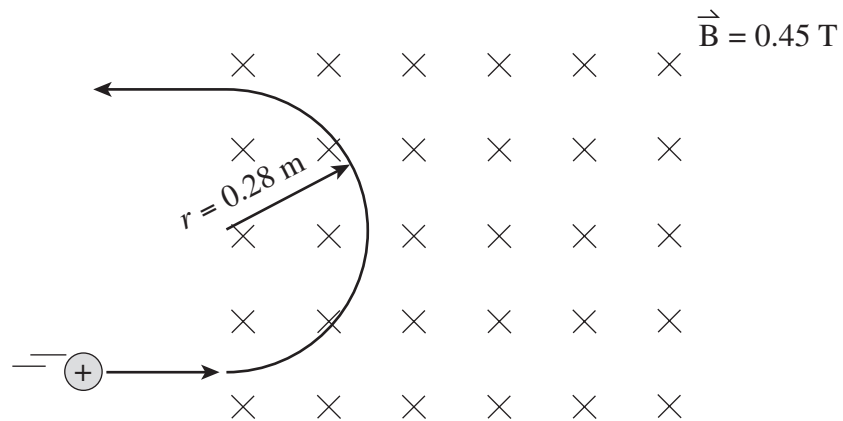


Calculate the speed of the proton when it is 3.0 m from the fixed charge.

A deuteron (charge $+e$, mass $2m_p$) is placed at the same starting position as the proton.
Explain why the speed of the deuteron at the 3.0 m mark is different than that of the proton.

4. (5 marks)

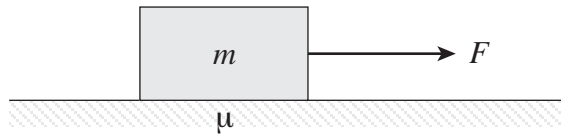
A proton travelling at a high velocity enters a 0.45 T magnetic field and travels in a circular path of radius 0.28 m as shown.



What is the kinetic energy of the proton?

5. (5 marks)

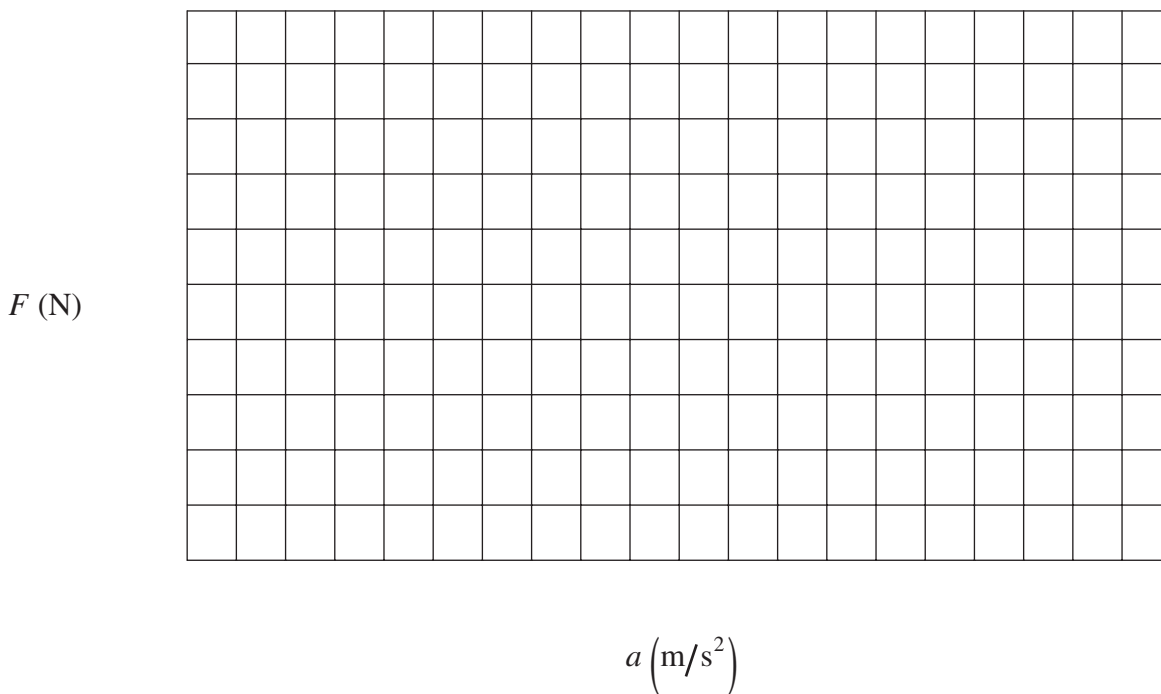
A force (F) was used to pull a wooden block across a floor as shown below.



The size of the force was varied and the data table below shows the size of the force and the block's resulting acceleration.

F (N)	a (m/s^2)
20	0.25
25	0.85
30	1.35
35	1.95

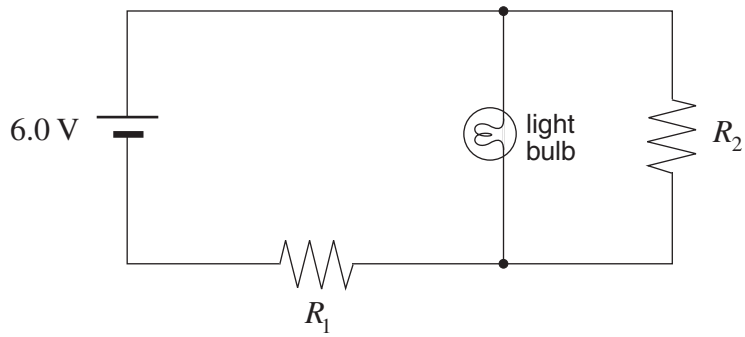
Plot the data on the graph below and draw a line of best fit. Extend the line back to the 'y' axis so that you have a y-intercept point and determine the slope of the line.



Using your slope value and your y -intercept value from the graph, determine the coefficient of friction between the block and the floor.

6. (4 marks)

A student initially sets up a circuit containing two resistors and a light bulb, as shown.



The student notes the brightness of the light bulb. Using principles of physics, explain what happens to the brightness of the light bulb when resistor R_2 is removed.

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 a student breaks any of the following rules:
 - Candidates 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.
 - Candidates 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.
 - Candidates 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.
 - Candidates must not communicate with another student during the examination.
 - Candidates must not remove any piece of the examination materials from the examination room, including work pages.
 - Candidates must not take or knowingly use any secure examination materials prior to the examination session.
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.