



Physics 12
Examination Booklet
2008/09 Released Exam
June 2009
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% 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.

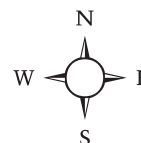
You have **Examination Booklet Form A**. In the box above #1 on your **Answer Sheet**, fill in the bubble as follows.

Exam Booklet Form/ Cahier d'examen	A	B	C	D	E	F	G	H
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1. Which of the following is a vector quantity?

- A. work
- B. electric field
- C. potential energy
- D. potential difference

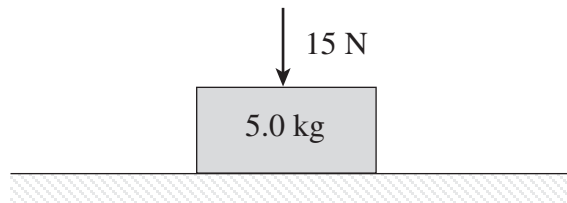
2. An aircraft is flying due south. Some time later it is flying due east. Which vector best represents the aircraft's change in velocity?



- A.  B.  C.  D. 

3. A red ball is launched from level ground with an initial velocity of 28 m/s , 40° above the horizontal. How far above the ground is the ball 2.0 s later?
- A. 16 m
 - B. 23 m
 - C. 36 m
 - D. 56 m
4. The gravitational field strength of the earth at its surface is best expressed as
- A. 9.8 J
 - B. $9.8 \text{ kg} \cdot \text{m/s}^2$
 - C. 9.8 N/kg^2
 - D. 9.8 N/kg

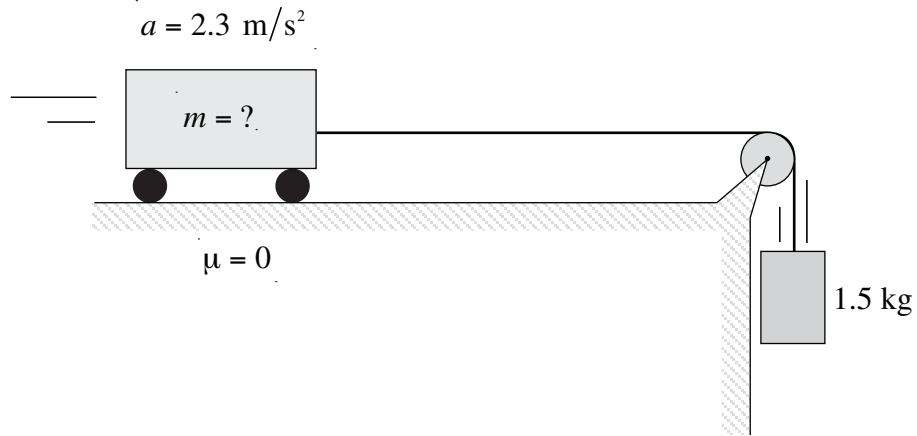
5. A 15 N force is applied to a 5.0 kg block as shown.



What is the normal force on the block?

- A. 15 N
- B. 34 N
- C. 49 N
- D. 64 N

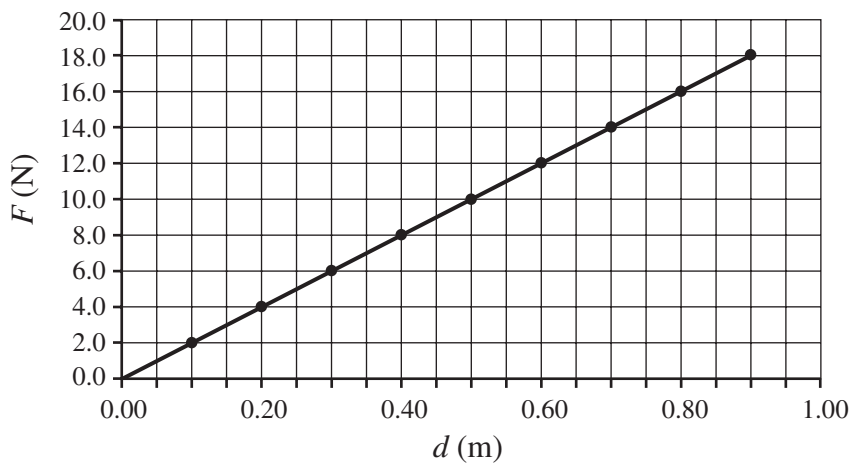
6. A light cord connects a moving cart to a mass over a pulley as shown.



If the cart is accelerating at 2.3 m/s^2 , what is its mass?

- A. 2.8 kg
- B. 3.5 kg
- C. 4.9 kg
- D. 6.4 kg

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

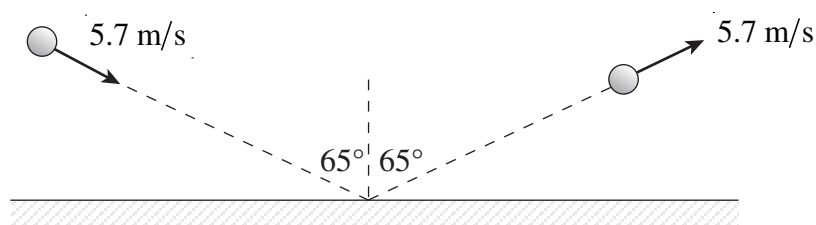


What is the work done by this force as it moves the object from 0.40 to 0.60 m?

- A. 0.80 J
- B. 2.0 J
- C. 3.2 J
- D. 20 J

8. Joe climbs a small hill from an elevation of 250 m to an elevation of 490 m. In doing so he expends 2.8×10^5 J. Joe's mass is 75 kg. What is his climbing efficiency?
- A. 0.37
B. 0.63
C. 0.66
D. 0.78

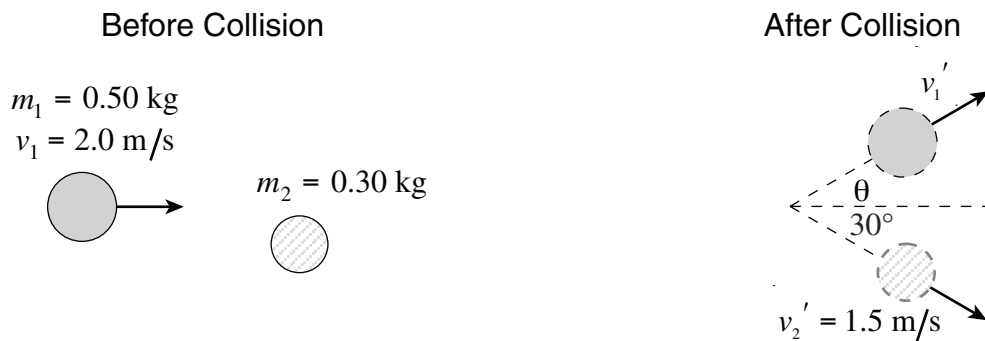
9. A 0.25 kg ball strikes the wall at 5.7 m/s and rebounds with the same speed and angle to the wall as shown. The ball's contact time was 0.22 s.



What was the magnitude of the impulse on this ball?

- A. 0.60 N·s
B. 1.2 N·s
C. 2.6 N·s
D. 7.4 N·s
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 m/s. An explosion is used to separate the two, which causes an increase in the speed of the space vehicle. The explosion lasts 2.2 s and exerts an impulse of 4.1×10^5 N·s on both the space vehicle and the booster unit. What is the speed of the space vehicle after the separation?
- A. 400 m/s
B. 430 m/s
C. 480 m/s
D. 490 m/s

11. A 0.50 kg puck moving at 2.0 m/s collides obliquely with a stationary 0.30 kg puck. After the collision the 0.30 kg puck moves as shown.



What is the speed of the 0.50 kg puck after the collision?

- A. 1.0 m/s
B. 1.3 m/s
C. 1.8 m/s
D. 2.2 m/s
12. Three horizontal forces are acting at the same point on a puck lying on a level frictionless table. The puck is in translational equilibrium.

Two of these forces are:

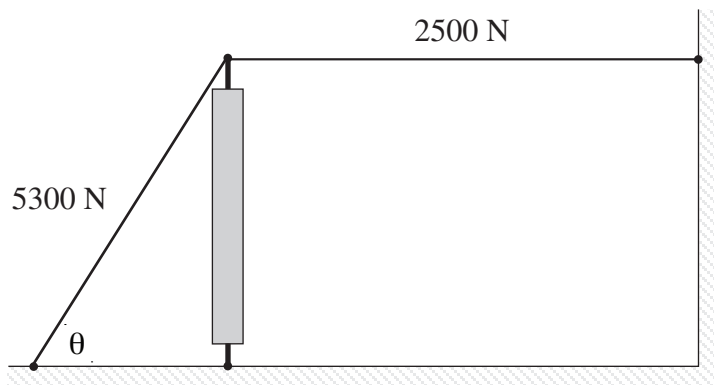
$$F_1 = 10.2 \text{ N, east}$$

$$F_2 = 15.4 \text{ N, } 30^\circ \text{ E of N}$$

What is the magnitude of the third force?

- A. 5.2 N
B. 15.6 N
C. 18.5 N
D. 22.3 N

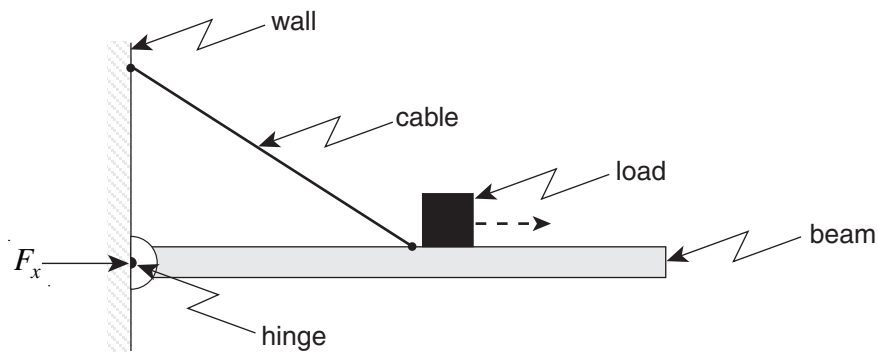
13. Two cables support a vertical tower. The tension in each cable is shown.



What is the angle θ ?

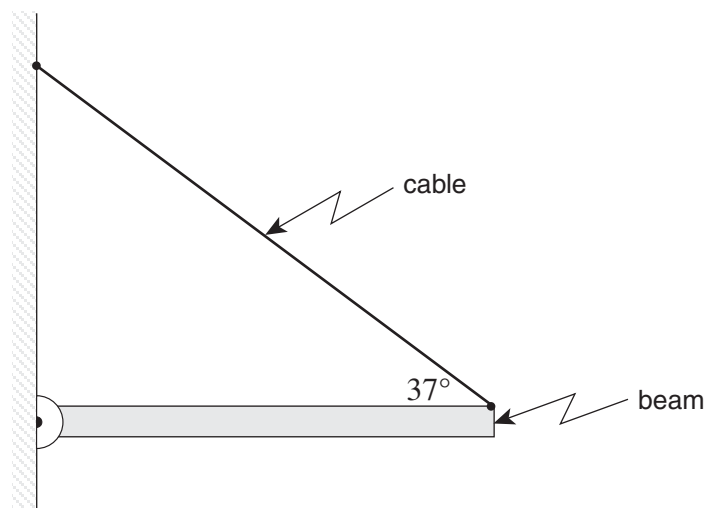
- A. 25°
- B. 28°
- C. 62°
- D. 65°

14. If the load on the uniform beam shown below is moved to the right, how do the tension force F_T in the cable and the horizontal force F_x that the hinge exerts on the beam change?



	TENSION FORCE F_T	HORIZONTAL FORCE F_x
A.	Decrease	Decrease
B.	Decrease	Increase
C.	Increase	Decrease
D.	Increase	Increase

15. A uniform 3.0 m long beam is supported by a cable as shown. The tension in the cable is 530 N.

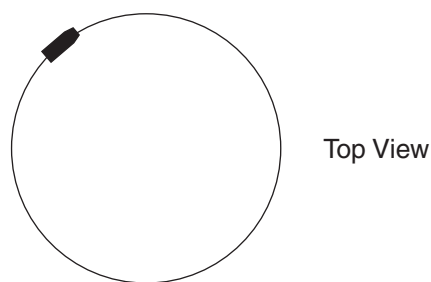


What is the mass of the beam?

- A. 33 kg
- B. 43 kg
- C. 65 kg
- D. 86 kg

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 the same time T . 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. $4/1$

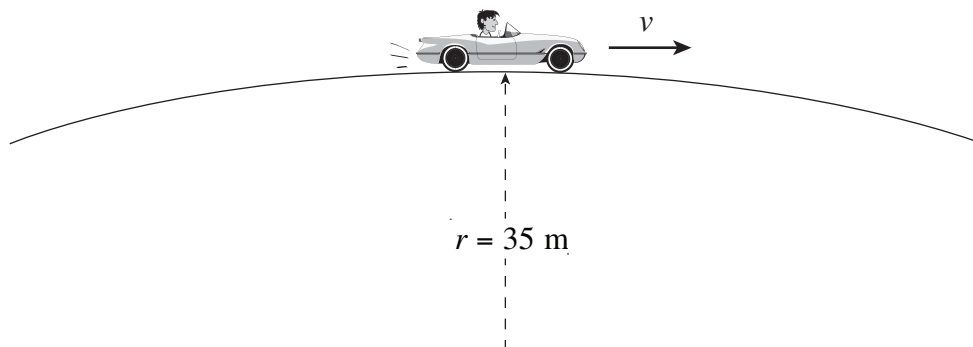
17. An object is in clockwise uniform horizontal circular motion.



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

	DIRECTION OF THE VELOCITY	DIRECTION OF THE CENTRIPETAL ACCELERATION
A.		
B.		
C.		
D.		

18. A driver in a car of mass 1200 kg travelling over a circular hill of radius 35 m experienced an apparent weight of 60% his normal weight ($F_N = 0.60 F_g$).



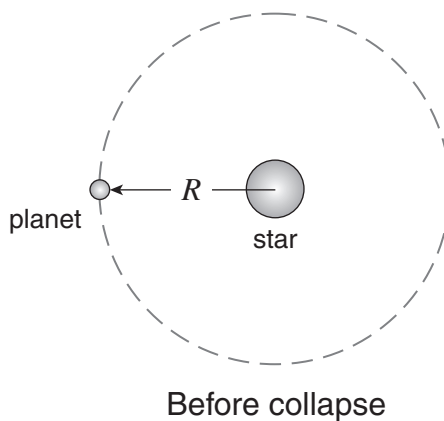
What was his speed at the top of this hill?

- A. 12 m/s
 - B. 14 m/s
 - C. 19 m/s
 - D. 23 m/s
19. A satellite is placed in an orbit at a distance R from the centre of the earth. It is then moved to a new orbit of distance $2R$ from the earth's centre. Which of the following is the correct ratio of the gravitational force in the new orbit to that of the old orbit?
- A. 1/4
 - B. 1/2
 - C. 2/1
 - D. 4/1

20. An explorer spacecraft is descending towards Mars using a rocket engine for braking. The spacecraft has $E_p = -2.8 \times 10^{10} \text{ J}$ and $E_k = 3.0 \times 10^9 \text{ J}$ at its initial position. Some time later the spacecraft has $E_p = -3.4 \times 10^{10} \text{ J}$ and $E_k = 1.0 \times 10^9 \text{ J}$. How much work did the rocket engine do in braking the spacecraft?

- A. $-2.0 \times 10^9 \text{ J}$
- B. $-4.0 \times 10^9 \text{ J}$
- C. $-6.0 \times 10^9 \text{ J}$
- D. $-8.0 \times 10^9 \text{ J}$

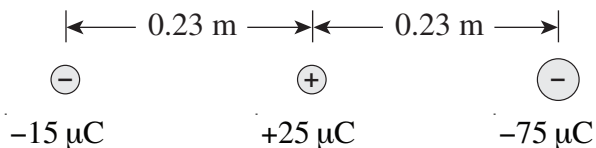
21. A planet is in an orbit of radius R around a star. The star collapses to $\frac{1}{10}$ of its original volume while maintaining all of its mass.



What happens to the planet's orbital radius due to the collapse of the star?

- A. reduced to $\frac{1}{100} R$
- B. reduced to $\frac{1}{10} R$
- C. remains unchanged
- D. increased to $10 R$

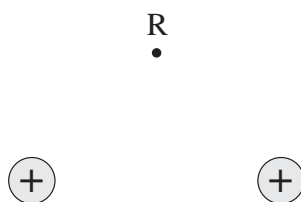
22. Three point charges are arranged as shown below.



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

	MAGNITUDE OF ELECTRIC FORCE	DIRECTION OF ELECTRIC FORCE
A.	16 N	Right
B.	16 N	Left
C.	110 N	Right
D.	110 N	Left

23. Two equally charged particles are placed close together as shown below.



Which of the following shows the net electric field due to these two particles at point R?

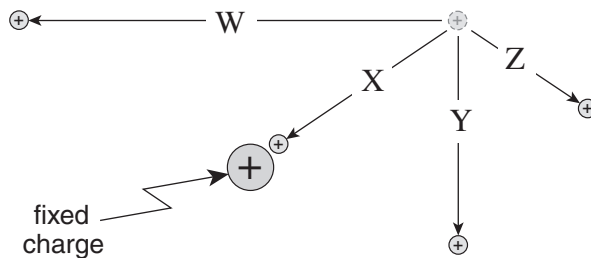
A. \longrightarrow

B. \longleftarrow

C. \downarrow

D. \uparrow

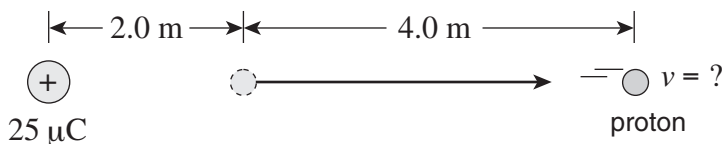
24. A small test charge is moved to several different locations near a larger fixed charge as shown.



Which change in position of the smaller charge would require the most work?

- A. W
- B. X
- C. Y
- D. Z

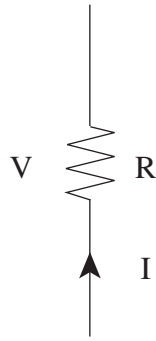
25. A proton initially held at rest 2.0 m away from a fixed 25 μC charge is released. The proton accelerates to the right as shown.



What is the speed of the proton when it is 6.0 m away from the 25 μC charge?

- A. $2.7 \times 10^6 \text{ m/s}$
- B. $3.3 \times 10^6 \text{ m/s}$
- C. $3.8 \times 10^6 \text{ m/s}$
- D. $4.6 \times 10^6 \text{ m/s}$

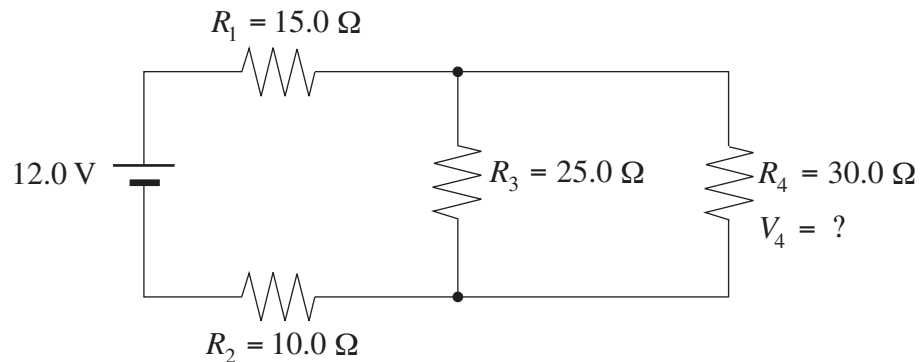
26. Consider the circuit element shown below.



The voltage across the resistor increases from V to $2V$. The resistance remains the same. By what factor has the current changed?

- A. $\frac{1}{4}$
- B. $\frac{1}{2}$
- C. 2
- D. 4

27. A 12.0 V power supply is connected to 4 resistors as shown.

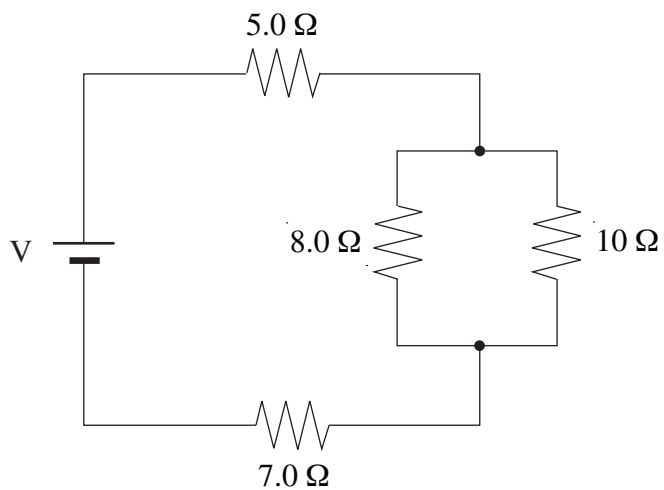


What is the potential difference, V_4 , across the $30.0\ \Omega$ resistor?

- A. 2.12 V
- B. 4.24 V
- C. 9.32 V
- D. 12.0 V

28. An electric motor is being supplied with 500 W of power at 120 V. The resistance of the motor is 8.0Ω . What current is being supplied to the motor?
- A. 4.2 A
 B. 7.9 A
 C. 15 A
 D. 63 A

29. A power source is providing a constant voltage, V , to the circuit shown below.

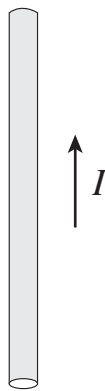


If the 8.0Ω resistor is removed from the circuit what happens to the equivalent resistance of the circuit and the current through the 7.0Ω resistor?

	EQUIVALENT RESISTANCE OF THE CIRCUIT	CURRENT THROUGH 7.0Ω RESISTOR
A.	Increases	Decreases
B.	Decreases	Increases
C.	Increases	Increases
D.	Decreases	Decreases

30. A coil of area 0.70 m^2 is in a 0.20 T magnetic field which is perpendicular to the face of the coil. What is the magnetic flux through the coil?
- A. 0.10 Wb
 - B. 0.14 Wb
 - C. 0.29 Wb
 - D. 3.5 Wb

31. A conducting wire is carrying a current towards the top of the page as shown below.



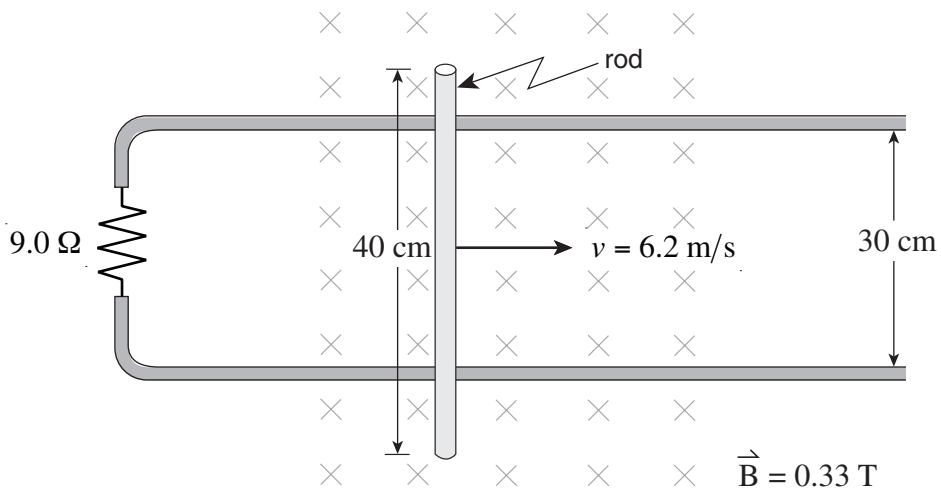
Due to the presence of a magnetic field, the wire is experiencing a magnetic force directed to the left. What is the direction of the magnetic field?

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

32. A proton travelling at a certain speed follows a circular path of radius 0.24 m while in a magnetic field. An alpha particle with twice the charge and four times the mass of the proton is travelling at the same speed inside the same magnetic field. (Both particles are travelling perpendicular to the field.) What is the radius of the alpha particle's path?

- A. 0.12 m
- B. 0.24 m
- C. 0.48 m
- D. 0.96 m

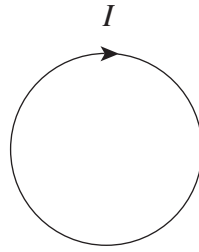
33. A conducting rod is placed on a U-shaped metal conductor containing a $9.0\ \Omega$ resistor. The rod is moved to the right at a constant speed of $6.2\ \text{m/s}$ through a $0.33\ \text{T}$ magnetic field as shown.



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

	MAGNITUDE OF CURRENT	DIRECTION OF CURRENT
A.	68 mA	towards top of page
B.	68 mA	towards bottom of page
C.	91 mA	towards top of page
D.	91 mA	towards bottom of page

34. Due to the presence of a changing magnetic field a current is flowing in the single circular loop of conducting wire as shown below.



Which of the following correctly describes the magnetic field?

- A. directed to the left and increasing
 - B. directed to the right and increasing
 - C. directed into the page and increasing
 - D. directed out of the page and increasing
35. The back emf being produced by an electric motor is increasing. The applied voltage is constant. Which of the following is correct?
- A. The current through the motor is constant.
 - B. The current through the motor is increasing.
 - C. The current through the motor is decreasing.
 - D. The current through the motor is increasing then decreasing.

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

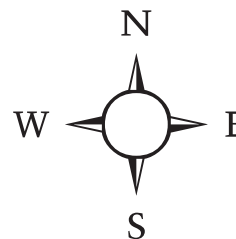
radius	$= 1.74 \times 10^6 \text{ m}$
mass	$= 7.35 \times 10^{22} \text{ kg}$
period of rotation.....	$= 2.36 \times 10^6 \text{ s}$
radius of orbit around Earth.....	$= 3.84 \times 10^8 \text{ m}$
period of orbit around Earth.....	$= 2.36 \times 10^6 \text{ s}$

Sun

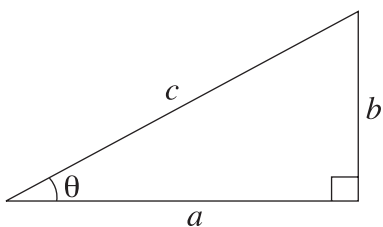
mass	$= 1.98 \times 10^{30} \text{ kg}$
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MATHEMATICAL FORMULAE

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:

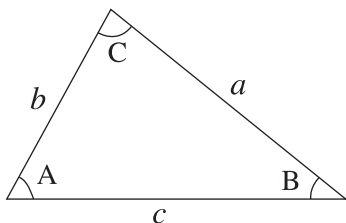


$$a^2 + b^2 = c^2$$

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

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

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
JUNE 2009

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.

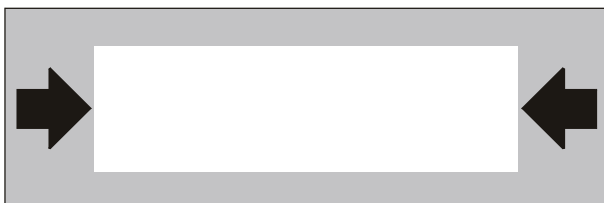
Question 1									
0	1	2	3	4	5	6	(.5)	NR	
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Question 2									
0	1	2	3	4	5		(.5)	NR	
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Question 3									
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Question 4									
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Question 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"/>	
Question 6									
0	1	2	3	4				NR	
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MINISTRY USE ONLY



Place Personal Education Number (PEN) here.



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Physics 12

2008/2009 Released Exam

JUNE 2009

Response Booklet



**BRITISH
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PART B: WRITTEN RESPONSE

Value: 30% of the examination

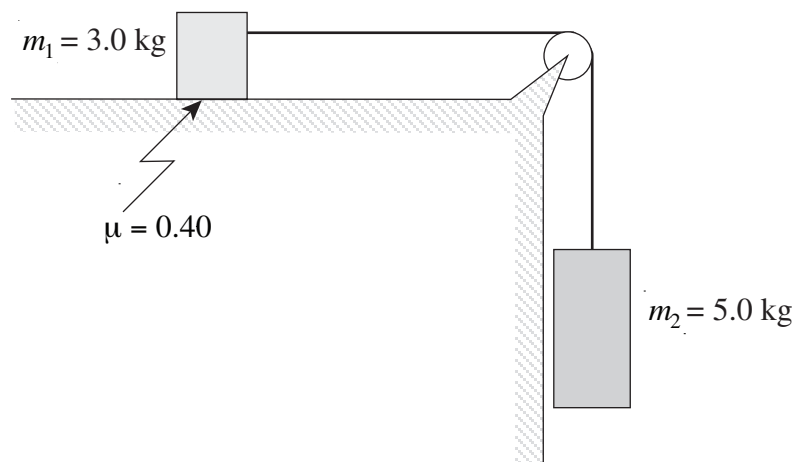
Suggested Time: 50 minutes

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. (6 marks)

Two masses are connected by a light cord over a frictionless pulley as shown below. The masses are initially held at rest by students doing a dynamics lab.

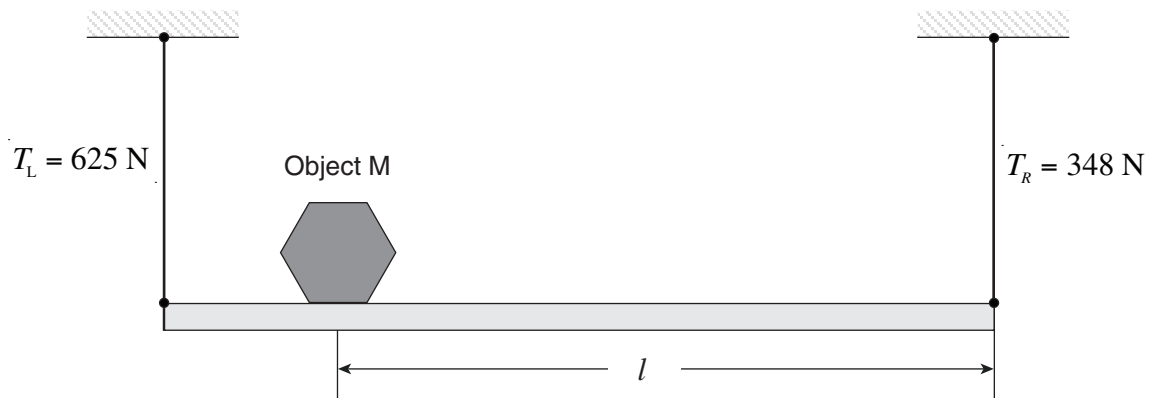


Determine the acceleration of the system of masses when they are released.

Student B tells Student A that mass m_2 must be greater than mass m_1 if this system is to accelerate. Explain why this need not be the case.

2. (5 marks)

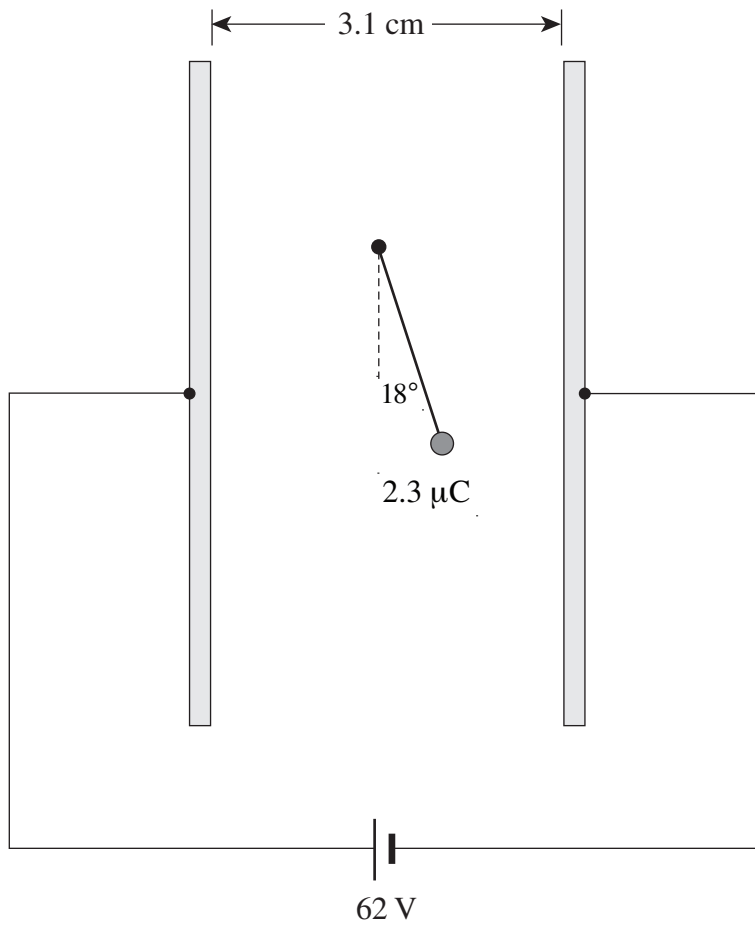
Two vertical wires with tensions as indicated support a uniform 14 kg, 3.0 m-long beam carrying an object of mass M as shown.



At what distance l from the right-hand wire is the object located?

3. (5 marks)

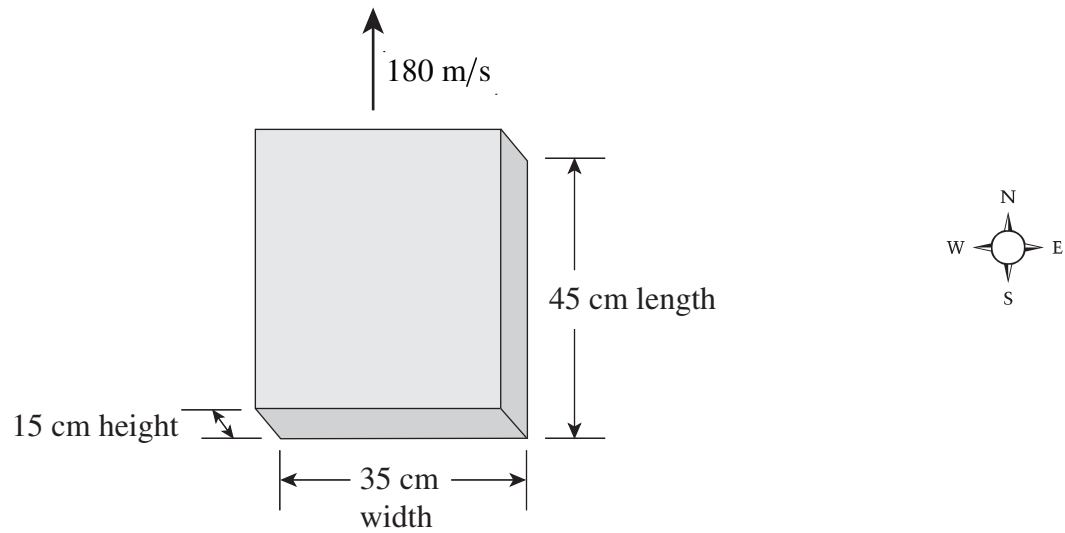
A small sphere having a charge of $2.3 \mu\text{C}$ is suspended from a thread hanging between two charged plates as shown.



What is the mass of the small sphere?

4. (5 marks)

A block of metal moves north at 180 m/s, perpendicular to a magnetic field.



If an electron in the block experiences a force of 7.2×10^{-18} N vertically upwards out of the page, what are the magnetic field strength and direction?

What is the potential difference developed across this block?

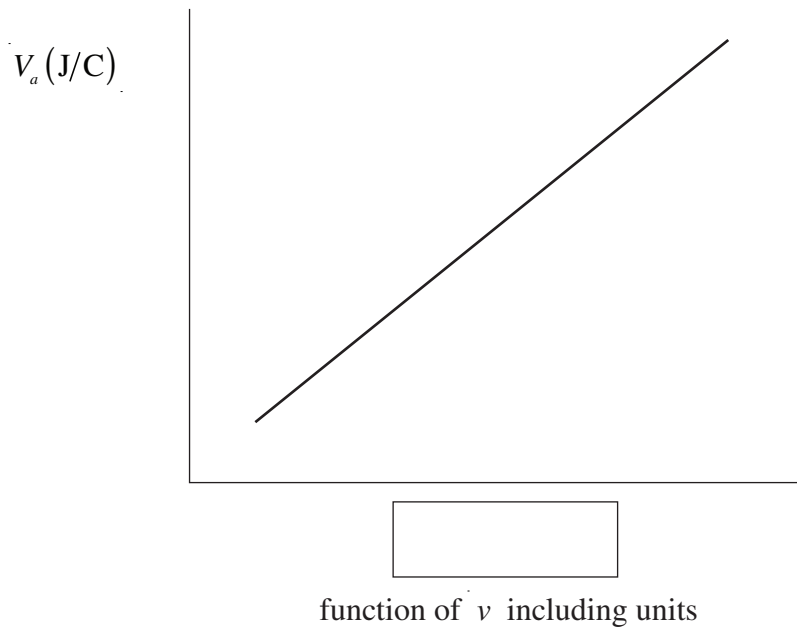
5. (5 marks)

During an electrostatics experiment a small positively charged plastic sphere is accelerated from rest through several different voltages, V_a .

The final velocity, v , of the sphere is recorded for each different accelerating voltage, V_a . The charge, q , on the sphere is the same in each case.

It is possible to use this data to create a linear graph and obtain a slope.

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



Clearly explain how you can use the slope of this graph to determine the charge q on the plastic sphere if you are given its mass.

6. (4 marks)

Student A states that there is no force due to gravity acting on the International Space Station (ISS). He states this must be so as he has seen television coverage showing astronauts and equipment floating around in the spacecraft.

Student B states that this is a common misconception for orbiting spacecraft, such as the ISS.

Using principles of physics, help Student B convince Student A that there must be a force due to gravity acting on the ISS.

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.