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Physics 12

AUGUST 2004

Course Code = PH

Student Instructions

1. Place the stickers with your Personal Education Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Personal Education Number, to appear on this booklet.**
2. Ensure that in addition to this examination booklet, you have an **Examination Response Form**. Follow the directions on the front of the Response Form.
3. **Disqualification** from the examination will result if you bring books, paper, notes or unauthorized electronic devices into the examination room.
4. When instructed to open this booklet, **check the numbering of the pages** to ensure that they are numbered in sequence from page one to the last page, which is identified by

END OF EXAMINATION

.
5. At the end of the examination, place your Response Form inside the front cover of this booklet and return the booklet and your Response Form to the supervisor.

Question 1:

1. .

(7)

Question 8:

8. .

(5)

Question 2:

2. .

(9)

Question 9:

9. .

(4)

Question 3:

3. .

(7)

Question 4:

4. .

(7)

Question 5:

5. .

(7)

Question 6:

6. .

(7)

Question 7:

7. .

(7)

PHYSICS 12

AUGUST 2004

COURSE CODE = PH

GENERAL INSTRUCTIONS

1. Aside from an approved calculator, electronic devices, including dictionaries and pagers, are **not** permitted in the examination room.
2. All multiple-choice answers must be entered on the Response Form using an **HB pencil**. Multiple-choice answers entered in this examination booklet will **not** be marked.
3. For each of the written-response questions, write your answer in the space provided in this booklet. 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.
4. Ensure that you use language and content appropriate to the purpose and audience of this examination. Failure to comply may result in your paper being awarded a zero.
5. This examination is designed to be completed in **two hours**. *Students may, however, take up to 30 minutes of additional time to finish.*

PHYSICS 12 PROVINCIAL EXAMINATION

- | | Value | Suggested Time |
|---|-------------------------|--------------------|
| 1. This examination consists of two parts: | | |
| PART A: 30 multiple-choice questions worth two marks each | 60 marks | 60 minutes |
| PART B: 9 written-response questions | 60 marks | 60 minutes |
| | Total: 120 marks | 120 minutes |
2. The last **three** pages inside the back cover contain the **Table of Constants, Mathematical Equations, Formulae, and Rough Work for Multiple-Choice**. These pages may be detached for convenient reference prior to writing this examination.
3. **A calculator is essential for the Physics 12 Provincial Examination.** The calculator must be a hand-held device designed primarily for mathematical computations involving logarithmic and trigonometric functions and may be capable of performing graphing functions. Computers, calculators with a QWERTY keyboard or symbolic manipulation abilities, and electronic writing pads will not be allowed. Students must not bring any external devices (peripherals) to support calculators such as manuals, printed or electronic cards, printers, memory expansion chips or cards, CD-ROMs, libraries or external keyboards. Students may have more than one calculator available during the examination, of which one may be a scientific calculator. Calculators may not be shared and must not have the ability to either transmit or receive electronic signals. In addition to an approved calculator, students will be allowed to use rulers, compasses, and protractors during the examination.
4. 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.
5. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution. Full marks will **not** be awarded for providing **only** a final answer.

If you are unable to determine the value of a quantity required in order to proceed, you may assume a reasonable value and continue toward the solution. Such a solution, however, may not be eligible for full marks.

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PART A: MULTIPLE CHOICE

Value: 60 marks (2 marks per question)

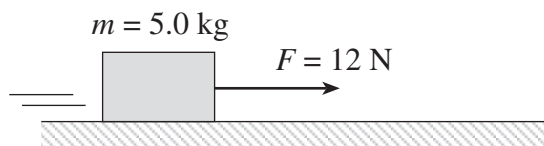
Suggested Time: 60 minutes

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

1. When an object is subjected to a constant positive net force it will experience a constant

- A. velocity.
- B. momentum.
- C. acceleration.
- D. displacement.

2. A 5.0 kg object is pulled at a constant speed by a horizontal 12 N force as shown in the diagram below.



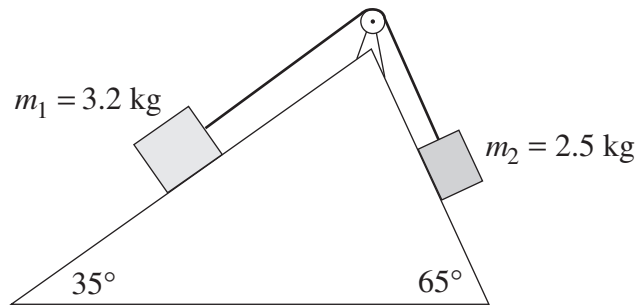
What is the coefficient of friction between the object and the surface?

- A. 0.24
 - B. 0.42
 - C. 1.0
 - D. 2.4
3. A falling 0.60 kg object experiences a frictional force due to air resistance of 1.5 N. What is the object's acceleration?
- A. 2.5 m/s^2
 - B. 4.4 m/s^2
 - C. 7.3 m/s^2
 - D. 12 m/s^2

OVER

4. A 1200 kg vehicle is accelerated from rest to 15 m/s over a distance of 85 m. What is the net force on the car during this acceleration?
- A. 1 600 N
 B. 3 200 N
 C. 6 800 N
 D. 10 000 N

5. Two masses on frictionless surfaces are connected by a light string as shown.

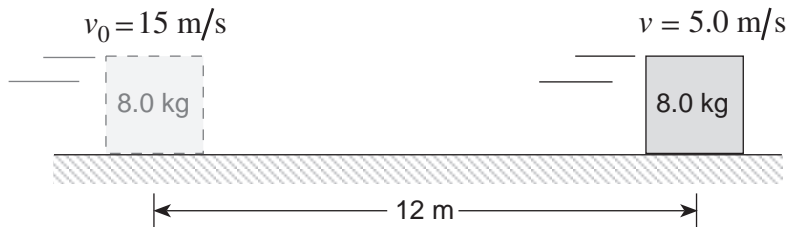


Determine the magnitude and direction of the acceleration of mass m_2 .

	ACCELERATION (m/s ²)	DIRECTION OF m_2
A.	0.74	up incline
B.	0.74	down incline
C.	1.2	up incline
D.	1.2	down incline

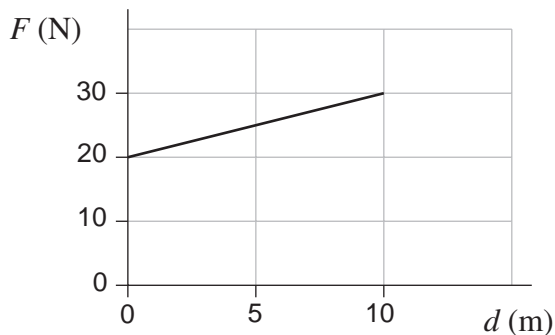
6. You drop an orange ball near the surface of the moon. Which of the following is true for the ball as it falls? (The moon has no atmosphere.)
- A. $E_p = \text{constant}$
 B. $E_k = \text{constant}$
 C. $E_p + E_k = \text{constant}$
 D. $E_p - E_k = \text{constant}$

7. An 8.0 kg wood block is sliding along on a concrete floor at 15 m/s as shown below.



After 12 m its speed has been reduced to 5.0 m/s by friction. How much work was done by friction over the 12 m distance?

- A. 100 J
B. 800 J
C. 900 J
D. 1000 J
8. An electric motor outputs 1500 W of power in pulling a 70 kg crate of fish up a very slippery loading ramp at a constant speed. The ramp is inclined 31° to the horizontal. Determine the speed of the crate. (Ignore friction.)
- A. 1.9 m/s
B. 2.1 m/s
C. 2.6 m/s
D. 4.2 m/s
9. The graph below shows the force exerted by a rope in lifting a 2.0 kg mass a vertical distance of 10 m from the ground.

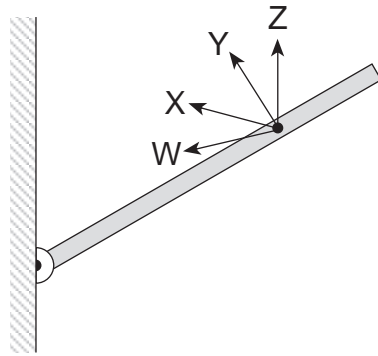


What is the final speed of the box at 10 m?

- A. 7.3 m/s
B. 10 m/s
C. 16 m/s
D. 21 m/s

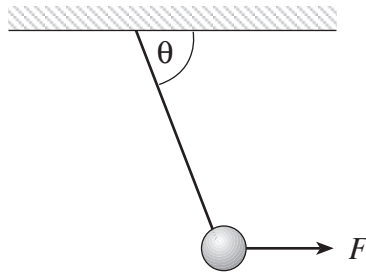
OVER

10. In which direction should a force act on the boom so that it creates a **minimum** torque about the hinge?



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

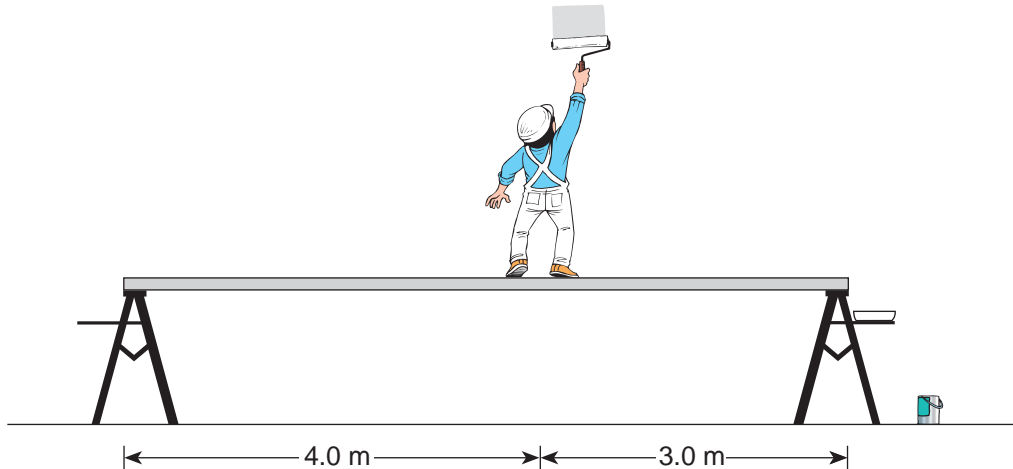
11. A 5.0 kg mass is suspended by a rope. A horizontally directed force F is applied to the mass.



What magnitude of force is needed to produce an angle of $\theta = 65^\circ$?

- A. 21 N
- B. 23 N
- C. 44 N
- D. 110 N

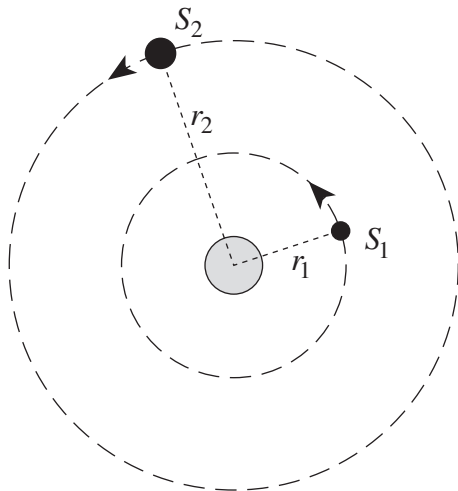
12. An 840 N painter stands on a 7.0 m board of negligible weight. The board is supported by two step-ladders as shown.



What is the force exerted on the board by the left step-ladder?

- A. 360 N
B. 420 N
C. 630 N
D. 840 N
13. The net force acting on a body in uniform circular motion is constant in
- A. direction only.
B. magnitude only.
C. both magnitude and direction.
D. neither magnitude nor direction.
14. A 1200 kg car travels with a maximum speed of 24 m/s in a circular path on a dry level road surface where $\mu = 0.90$ between the car tires and the road. What is the radius of this circular path?
- A. 27 m
B. 59 m
C. 65 m
D. 640 m

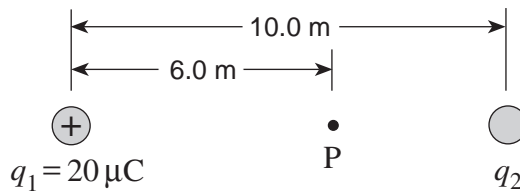
15. Two satellites, S_1 and S_2 , are in circular orbits around a planet. Satellite S_2 has twice the mass and twice the orbital radius of satellite S_1 .



What is the ratio of the centripetal force on S_2 to that of S_1 ($S_2:S_1$) ?

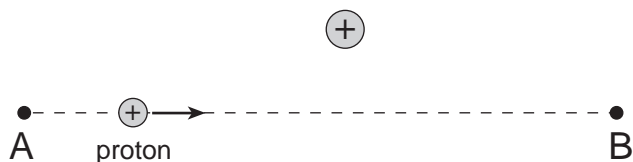
- A. 1:1
 - B. 1:2
 - C. 1:4
 - D. 1:8
16. Which of the following is a correct statement about gravity?
- A. An object falling freely has no gravitational force on it.
 - B. The acceleration due to gravity, g , is a universal constant.
 - C. The gravitational field of a body follows an inverse square law.
 - D. The gravitational potential energy varies with the square of distance of separation.
17. The mass of planet Neptune is 17 times more than that of the earth. It has a radius 3.8 times that of the earth. Which of the following is the best approximation of the acceleration due to gravity on the surface of Neptune?
- A. 8.3 m/s^2
 - B. 12 m/s^2
 - C. 44 m/s^2
 - D. 170 m/s^2

18. How much work is required to raise a 4.0×10^3 kg object to an altitude of 5.0×10^6 m above the earth's surface?
- A. 1.1×10^{11} J
 B. 1.4×10^{11} J
 C. 2.0×10^{11} J
 D. 2.5×10^{11} J
19. The magnitude of the force experienced by any charged object, q , when placed in an electric field is equal to which of the following?
- A. $\frac{V}{q}$
 B. $\frac{E_p}{q}$
 C. $\Delta V \cdot q$
 D. $E \cdot q$
20. The electric field at point P in the diagram below is 8500 N/C directed to the right. What is the size and polarity of charge q_2 ? ($1 \mu\text{C} = 1 \times 10^{-6}$ C)

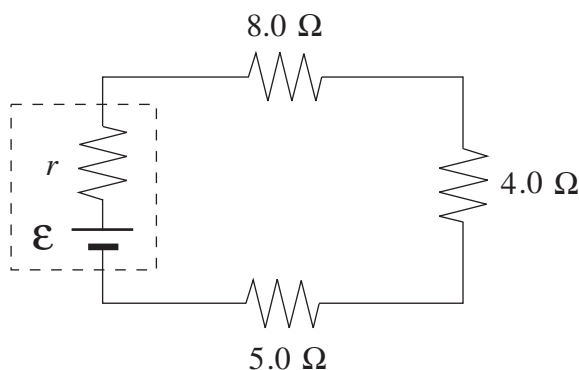


	POLARITY	SIZE
A.	+	$6.2 \mu\text{C}$
B.	-	$6.2 \mu\text{C}$
C.	+	$14 \mu\text{C}$
D.	-	$14 \mu\text{C}$

21. A proton is made to travel in a straight line near a fixed positively charged object as shown in the diagram below. What is happening to the proton's electric potential energy as it travels from A to B?



- A. It is increasing.
 B. It is decreasing.
 C. It is increasing then decreasing.
 D. It is decreasing then increasing.
22. The terminal voltage of a battery is always less than the emf of a battery when supplying current in a circuit because of a voltage drop due to
- A. the terminal connections.
 B. the battery's internal resistance.
 C. heating of resistors in the circuit.
 D. heating of the wires in the circuit.
23. When a resistor is added in parallel with the $4.0\ \Omega$ resistor in the circuit shown below, what happens to the voltage across the $5.0\ \Omega$ resistor and to the terminal voltage of the battery?

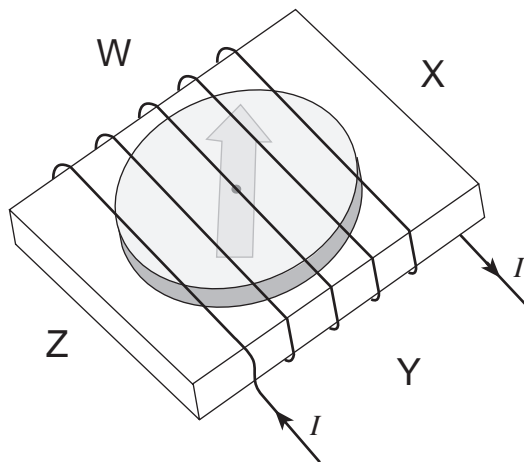


	VOLTAGE ACROSS $5.0\ \Omega$	TERMINAL VOLTAGE
A.	increases	decreases
B.	increases	increases
C.	decreases	decreases
D.	decreases	increases

24. What particles make up the beam in a cathode ray tube?

- A. atoms
- B. protons
- C. neutrons
- D. electrons

25. A coil of copper wire is wrapped around a compass as shown. Which way will the compass needle point when current flows through the coil?

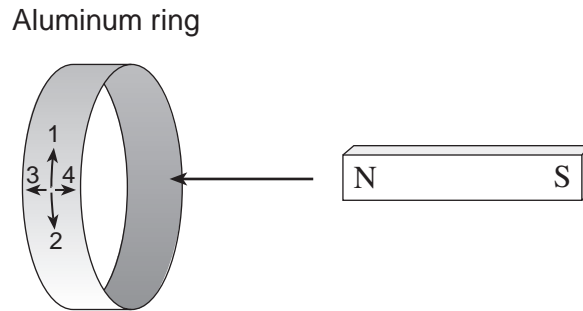


- A. W
- B. X
- C. Y
- D. Z

26. Protons move in circular paths of radius 1.2×10^{-2} m when travelling perpendicular to a 8.5×10^{-3} T magnetic field. What is the speed of these protons?

- A. 9.9×10^1 m/s
- B. 4.2×10^3 m/s
- C. 9.8×10^3 m/s
- D. 1.8×10^7 m/s

27. A magnet is moving towards an aluminum ring.

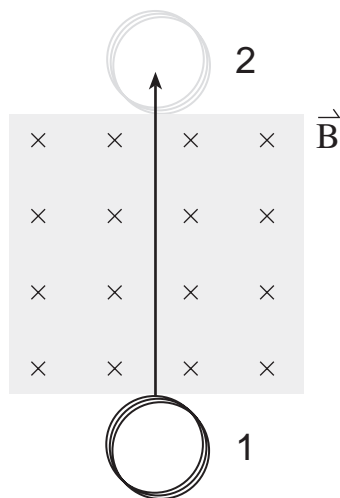


In which way will the current flow in the labelled portion of the ring as the magnet moves towards the ring?

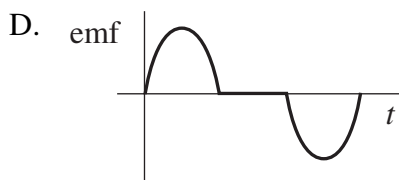
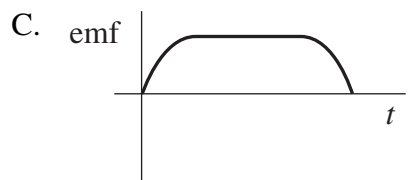
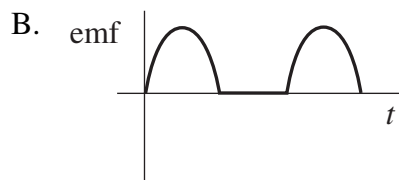
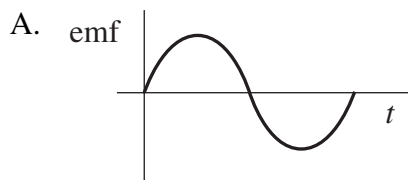
- A. towards 1
 - B. towards 2
 - C. towards 3
 - D. towards 4
28. A 240 V motor draws 9.0 A of current at start up. At normal operating speeds the same motor only draws 2.5 A. What is the back emf of this motor at normal operating speeds?
- A. 0.0 V
 - B. 67 V
 - C. 170 V
 - D. 240 V
29. A transformer is made up of 200 turns in the primary windings and of 50 turns in the secondary windings. The primary voltage is 120 V and the secondary current is 0.12 A. What is the primary current and secondary voltage for this transformer?

	PRIMARY CURRENT	SECONDARY VOLTAGE
A.	0.030 A	30 V
B.	0.030 A	480 V
C.	0.48 A	30 V
D.	0.48 A	480 V

30. A coil moves at a constant velocity across a region of magnetic field as shown.



Which of the following **best** shows the emf vs. time graph for the emf induced in the coil as it moves from 1 to 2?



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

OVER

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PART B: WRITTEN RESPONSE

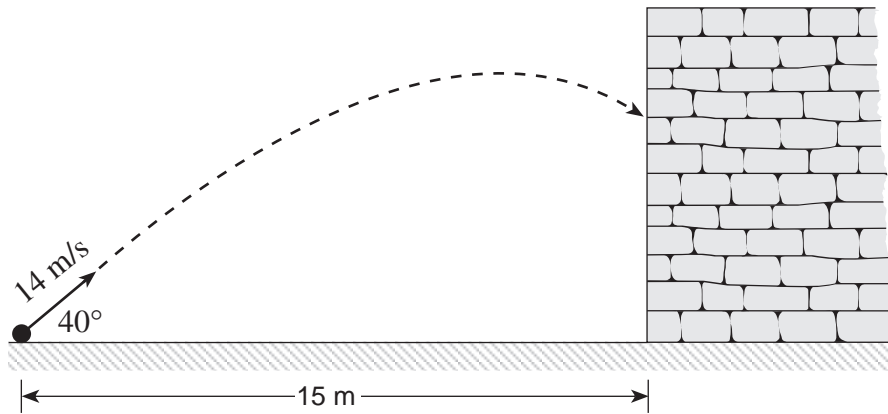
Value: 60 marks

Suggested Time: 60 minutes

INSTRUCTIONS:

1. Rough-work space has been incorporated into the space allowed for answering each written-response question. You may not need all of the space provided to answer each question.
2.
 - a) Final answers must include appropriate **units**.
 - b) Marks will not be deducted for answers expressed to **two** or **three** significant figures.
 - c) In this examination the zero in a number such as 30 shall be considered to be a significant zero.
3. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution.
4. If you are unable to determine the value of a quantity required in order to proceed, you may assume a reasonable value and continue toward the solution. Such a solution, however, may not be eligible for full marks.
5. **Full marks will NOT be awarded for providing only a final answer.**

1. A 2.5 kg projectile is launched towards a brick wall as shown.



a) What are horizontal and vertical components of the launch velocity? **(2 marks)**

ANSWER:

a) horizontal component: _____

vertical component: _____

b) How much time does it take for the projectile to reach the wall? **(2 marks)**

ANSWER:

b) time: _____

c) What is the projectile's impact speed with the wall?

(3 marks)

ANSWER:

c) impact speed: _____

OVER

2. A 5.30 kg wagon is moving at 2.00 m/s to the right. A 0.180 kg blob of putty moving at 32.0 m/s also to the right strikes the wagon and sticks to it.

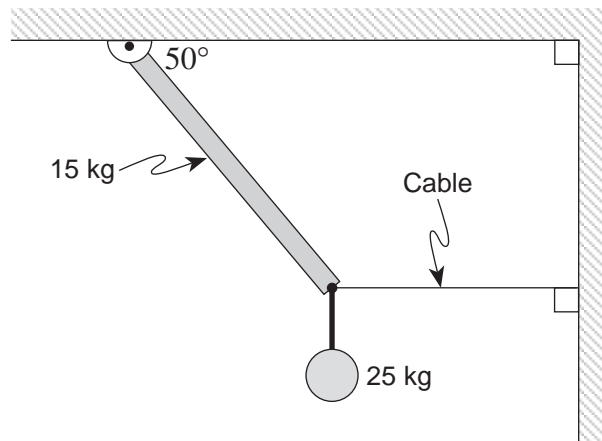
a) With what speed will the wagon and the putty move after the collision? **(5 marks)**

ANSWER:

a) final speed of wagon: _____

- b) Suppose the wagon had instead been struck by a ball with the same mass and speed as the putty and the ball rebounded to the left after the collision. How would the speed of the wagon compare with your answer to a)? Using principles of physics, give an explanation for your prediction. **(4 marks)**

3. A 4.0 m long uniform pole with a mass of 15 kg is pivoted at one end and held in position by a horizontal cable at the other end. If a 25 kg mass is suspended from the end of the pole, what is the tension in the horizontal cable? **(7 marks)**



ANSWER:

tension: _____

OVER

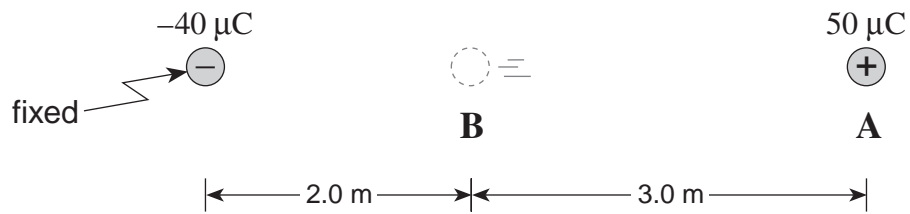
4. A 7.5×10^4 kg space vehicle leaves the surface of the earth with a speed of 1.3×10^4 m/s.
What will its speed be when it is infinitely far from the earth? **(7 marks)**

ANSWER:

speed: _____

OVER

5. A 1.0×10^{-3} kg styrofoam ball carrying $50 \mu\text{C}$ of charge is released from rest from position **A** as shown in the diagram below. ($1 \mu\text{C} = 1 \times 10^{-6}$ C)



- a) Determine the change in electric potential energy, ΔE_p , of the ball as it moves from position **A** to position **B**. **(5 marks)**

ANSWER:

a) ΔE_p of the ball: _____

b) What is the speed of the ball as it reaches position **B**? ($v_i = 0$ at **A**)

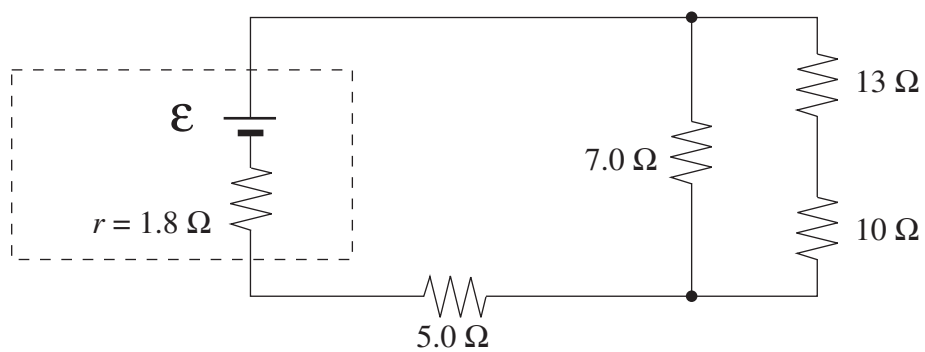
(2 marks)

ANSWER:

b) speed of the ball: _____

OVER

6. The internal resistance of the battery shown in the circuit below dissipates 10 W of power. Determine the current through the 13 Ω resistor. (7 marks)

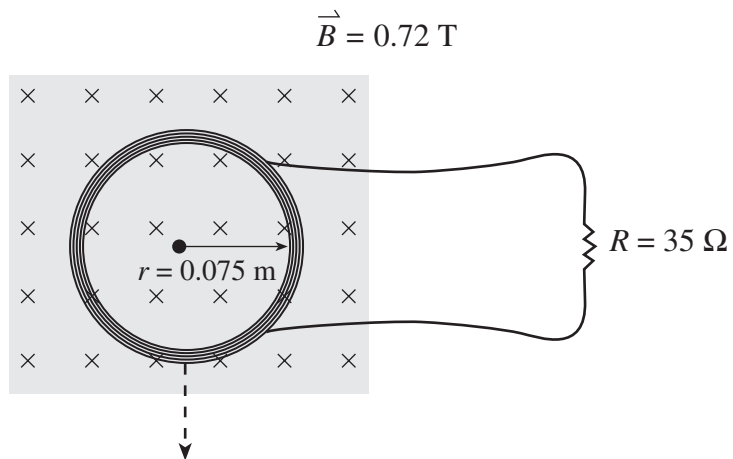


ANSWER:

current: _____

OVER

7. A 480-turn circular coil of radius 0.075 m is placed in a perpendicular magnetic field of 0.72 T. The coil is connected to a resistor of 35Ω as shown.



- a) Calculate the average current through the resistor as the coil is removed from the magnetic field in a time of 0.22 s. **(6 marks)**

ANSWER:

a) average current: _____

b) In which direction will the current flow in the coil?

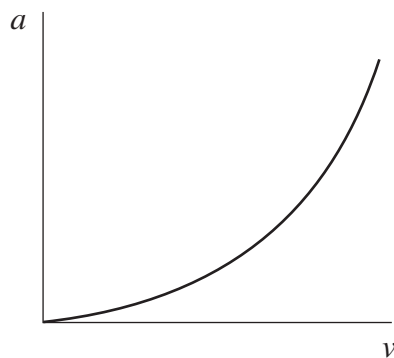
(1 mark)

- clockwise
- counterclockwise

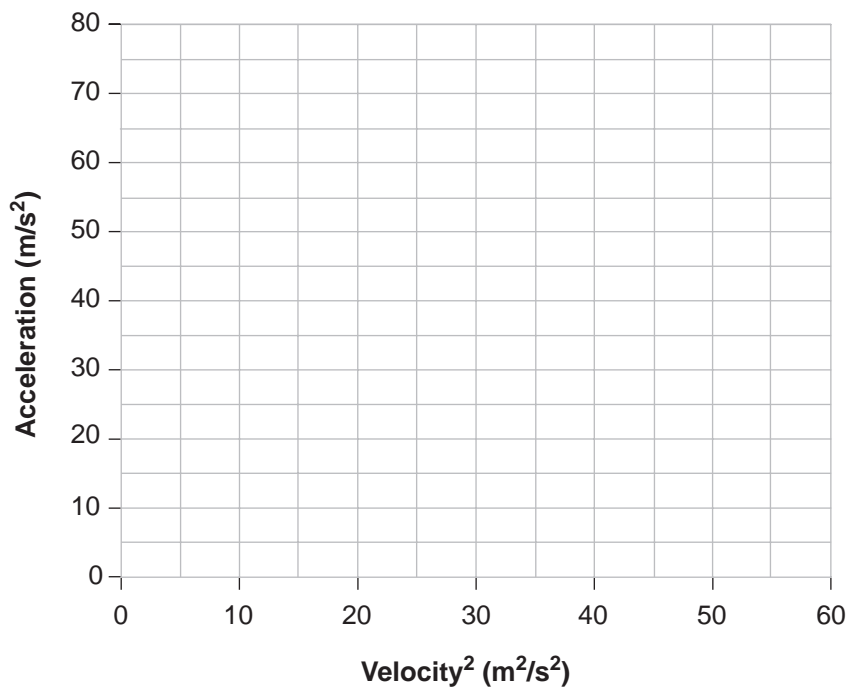
8. A student measures the acceleration of a lab cart as it moves at different speeds around a circular horizontal path. The data collected by the student is shown below:

ACCELERATION (m/s^2)	5.7	12.9	25.2	40	49.7	72
VELOCITY (m/s)	2.0	3.0	4.2	5.3	5.9	7.1

When a graph of acceleration versus velocity is plotted a curve results as shown.



- a) Manipulate the **velocity data** and use it to plot a straight line on the graph below. (3 marks)



b) Calculate the slope of this graph including units.

(2 marks)

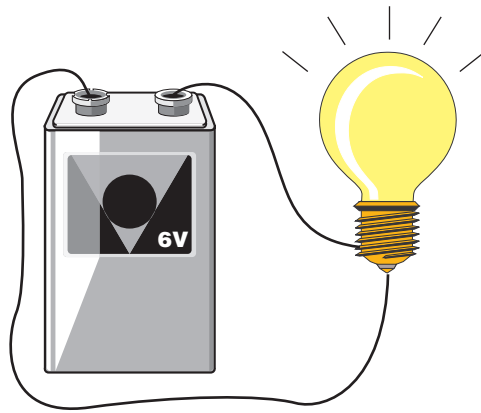
ANSWER:

b) slope of graph: _____

OVER

9. Explain why a 6.0 V battery feels warm to the touch when it is being used to run a low resistance light bulb.

(4 marks)



END OF EXAMINATION

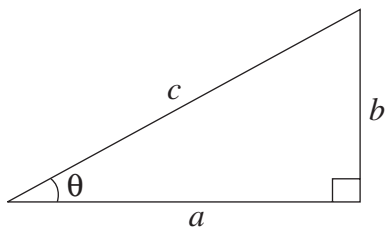
TABLE OF CONSTANTS

Gravitational constant.....	$G = 6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2/\text{kg}^2$
Acceleration due to gravity at the surface of Earth (for the purposes of this examination).....	$g = 9.80 \text{ m/s}^2$
Earth	
radius	$= 6.38 \times 10^6 \text{ m}$
radius of orbit about Sun	$= 1.50 \times 10^{11} \text{ m}$
period of rotation	$= 8.61 \times 10^4 \text{ s}$
period of revolution about Sun	$= 3.16 \times 10^7 \text{ s}$
mass	$= 5.98 \times 10^{24} \text{ kg}$
Moon	
radius	$= 1.74 \times 10^6 \text{ m}$
radius of orbit about Earth.....	$= 3.84 \times 10^8 \text{ m}$
period of rotation	$= 2.36 \times 10^6 \text{ s}$
period of revolution about Earth.....	$= 2.36 \times 10^6 \text{ s}$
mass	$= 7.35 \times 10^{22} \text{ kg}$
Sun	
mass	$= 1.98 \times 10^{30} \text{ kg}$
Constant in Coulomb's Law.....	$k = 9.00 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$
Elementary charge	$e = 1.60 \times 10^{-19} \text{ C}$
Mass of electron.....	$m_e = 9.11 \times 10^{-31} \text{ kg}$
Mass of proton.....	$m_p = 1.67 \times 10^{-27} \text{ kg}$
Mass of neutron.....	$m_n = 1.68 \times 10^{-27} \text{ kg}$
Permeability of free space	$\mu_o = 4\pi \times 10^{-7} \text{ T} \cdot \text{m/A}$
Speed of light	$c = 3.00 \times 10^8 \text{ m/s}$

**You may detach this page for convenient reference.
Exercise care when tearing along perforations.**

MATHEMATICAL EQUATIONS

For Right-angled Triangles:

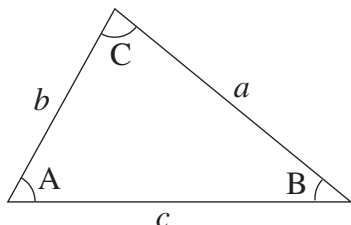


$$a^2 + b^2 = c^2$$

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

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

For All Triangles:



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

$$\sin 2A = 2 \sin A \cos A$$

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

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

Circle:

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

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

Sphere:

$$\text{Surface area} = 4\pi r^2$$

$$\text{Volume} = \frac{4}{3}\pi r^3$$

Quadratic Equation:

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

Vector Kinematics in Two Dimensions:

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

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

Vector Dynamics:

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

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

Work, Energy, and Power:

$$W = Fd \qquad E_p = mgh$$

$$E_k = \frac{1}{2}mv^2 \qquad P = \frac{W}{t}$$

Momentum:

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

Equilibrium:

$$\tau = Fd$$

Circular Motion:

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

Gravitation:

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

**You may detach this page for convenient reference.
Exercise care when tearing along perforations.**

Electrostatics:

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

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

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

Electric Circuits:

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

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

Electromagnetism:

$$F = BIl \quad F = QvB$$

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

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

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

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

ROUGH WORK FOR MULTIPLE-CHOICE

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ROUGH WORK FOR MULTIPLE-CHOICE