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BRITISH COLUMBIA

Physics 12

JUNE 2003

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. ☐ . ☐

(7)

Question 9:

9. ☐ . ☐

(4)

Question 3:

3. ☐ . ☐

(7)

Question 4:

4. ☐ . ☐

(9)

Question 5:

5. ☐ . ☐

(7)

Question 6:

6. ☐ . ☐

(7)

Question 7:

7. ☐ . ☐

(7)

PHYSICS 12

JUNE 2003

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

1. This examination consists of **two** parts:

		Value	Suggested Time
PART A:	30 multiple-choice questions worth two marks each	60	60
PART B:	9 written-response questions	60	60
	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. Which of the following is constant for all projectiles?

   A. vertical velocity
   B. horizontal velocity
   C. vertical displacement
   D. horizontal displacement

2. A projectile is launched at $30\ m/s$ over level ground at an angle of $37°$ to the horizontal. What maximum height does this projectile reach?

   A. 3.1 m
   B. 17 m
   C. 29 m
   D. 46 m

3. A few minutes after takeoff a jet is heading due east with an air speed of 300 km/h. If the wind is blowing at 60 km/h, towards $40°$ S of E, what is the jet's ground speed?

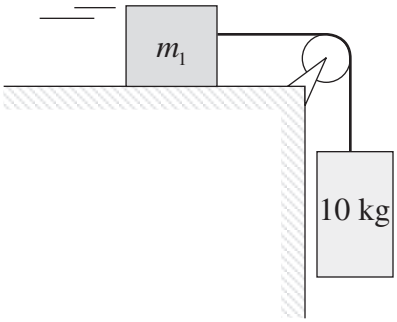
   A. 260 km/h
   B. 340 km/h
   C. 350 km/h
   D. 360 km/h

4. Which of the following statements is always correct about an object in motion?

   A. It has a tendency to accelerate.
   B. A net force must be acting on it.
   C. It has a tendency to keep moving.
   D. The net force acting on it must be zero.

OVER

5. If the tension in the line joining the two masses shown below is 12 N, what is the mass, m_1? (Ignore surface friction.)



A. 1.1 kg
B. 1.4 kg
C. 2.0 kg
D. 10 kg

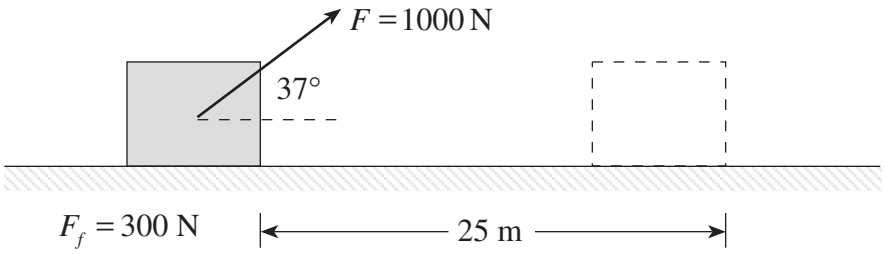
6. Power is

A. work done.
B. the change in energy.
C. the change in kinetic energy.
D. the rate of change in energy.

7. A motor using 1500 W takes 52 s to raise a 250 kg load vertically 24 m. What is the efficiency of this motor?

A. 7.7 %
B. 12 %
C. 25 %
D. 75 %

8. A 1000 N force is applied to a block as shown. There is 300 N of sliding friction as the block moves 25 m along the surface.



How much work was done by the applied force in moving this block?

A. 1.5×10^4 J

B. 1.8×10^4 J

C. 2.0×10^4 J

D. 2.7×10^4 J

9. What is the work done by the brakes of a 1500 kg car as they slow the car from 25 m/s to 15 m/s over a distance of 80 m ?

A. -2.6×10^4 J

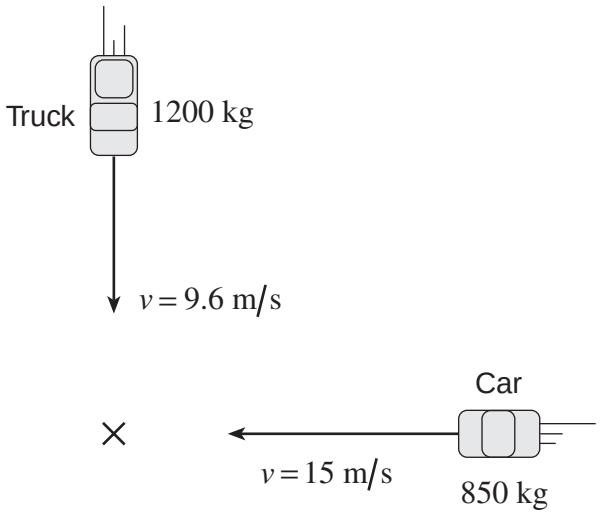
B. -7.5×10^4 J

C. -3.0×10^5 J

D. -1.2×10^6 J

OVER

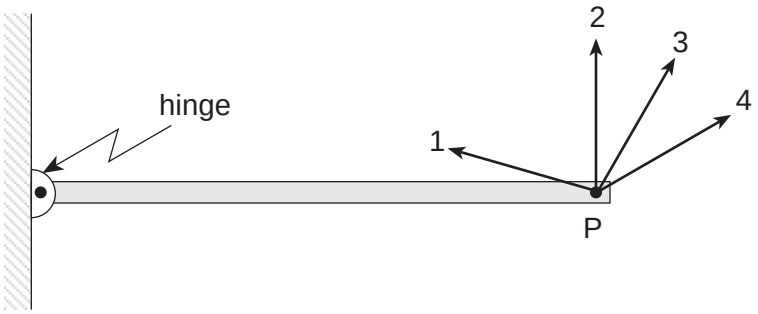
10. A 1200 kg truck travelling at 9.6 m/s due south runs into a 850 kg car travelling at 15 m/s due west. The two vehicles stick together after they collide.



With what speed does the combined mass move immediately after the collision?

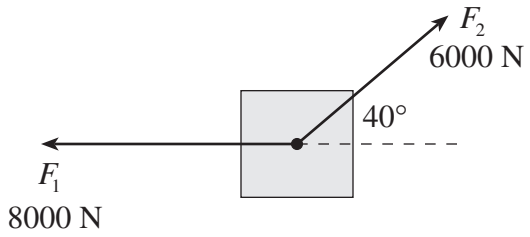
A. 0.60 m/s
B. 2.7 m/s
C. 8.4 m/s
D. 12 m/s

11. The diagram below shows a force F applied in several different directions at the point P on a hinged beam. In which direction will the force produce the **smallest** torque about the hinge?



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

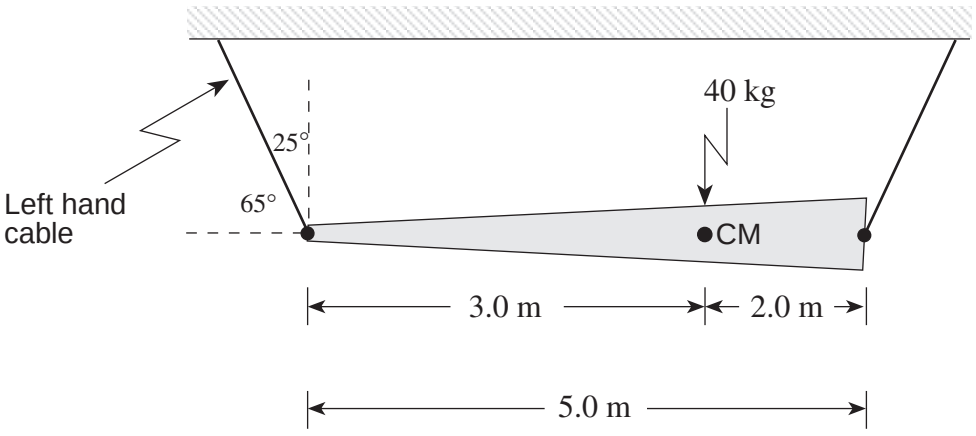
12. Two forces are acting at a single point on an object. Force 1 has a magnitude of 8000 N and is directed due W. Force 2 has a magnitude of 6000 N and is directed at 40° N of E.



Determine the magnitude of the third force which must act at the same point so that the object will be in translational equilibrium.

A. 2000 N
B. 3400 N
C. 5100 N
D. 6200 N

13. A 40 kg non-uniform beam (centre of mass CM) is supported by two cables.



(Diagram not to scale.)

What is the tension in the left hand cable?

A. 170 N
B. 260 N
C. 370 N
D. 560 N

OVER

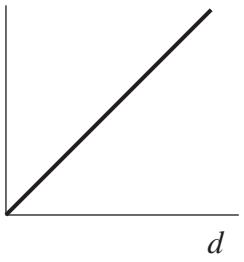
14. A car is travelling in uniform circular motion. Which of the following correctly describes the speed, velocity and acceleration of the car?

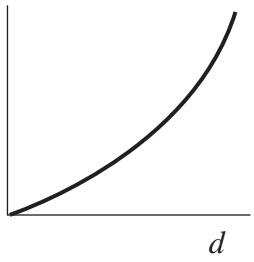
	SPEED	VELOCITY	ACCELERATION
A.	Constant	Constant	Constant
B.	Constant	Changing	Changing
C.	Changing	Constant	Constant
D.	Changing	Changing	Changing

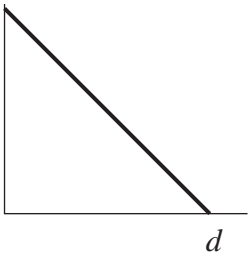
15. A 45 kg child stands on the rim of a merry-go-round of radius 2.3 m. The child completes 5 rotations in 72 s. What is the centripetal force acting on the child?

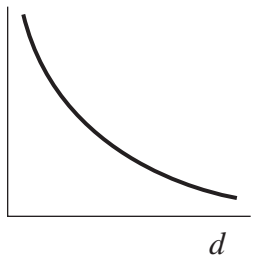
A. 0.44 N
B. 0.79 N
C. 20 N
D. 280 N

16. Which of the following represents the graph of gravitational field strength g as a function of the distance d from the centre of a planet?

A. 

B. 

C. 

D. 

17. Which of the following best represents the gravitational force of attraction between two people one metre apart?

A. 10^{-17} N

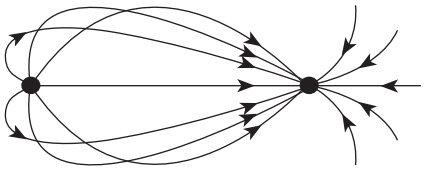
B. 10^{-12} N

C. 10^{-7} N

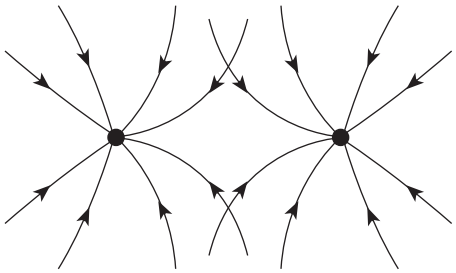
D. 10^{-2} N

18. Which of the following is a possible electric field configuration?

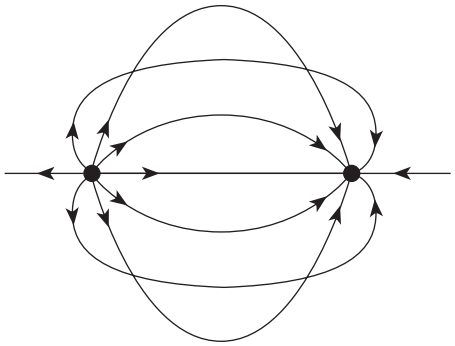
A.



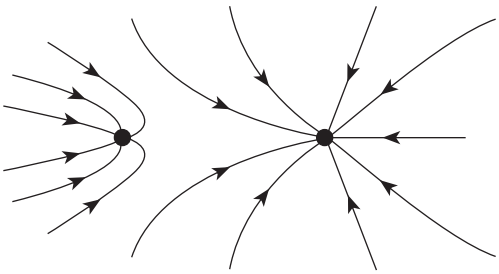
B.



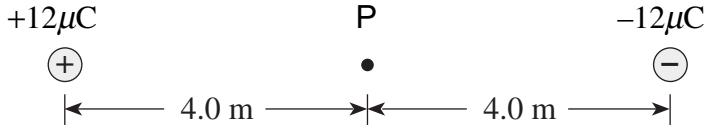
C.



D.



19. What is the electric potential at point P midway between the two point charges shown below? $\left(1\,\mu\text{C} = 1.0\times10^{-6}\text{ C}\right)$



A. 0 V

B. 6.8×10^{3} V

C. 1.4×10^{4} V

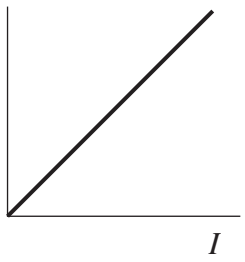
D. 5.4×10^{4} V

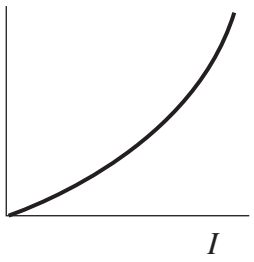
OVER

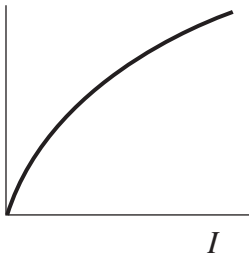
20. A proton is moving at 5.0×10^{6} m/s when it is 8.0 m from a fixed 1.5×10^{-5} C charge Q. What is the speed of the proton when it is 2.0 m from the fixed charge Q ?

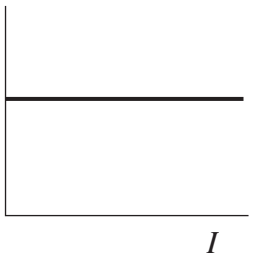
A. 2.5×10^{6} m/s
B. 3.6×10^{6} m/s
C. 3.9×10^{6} m/s
D. 4.5×10^{6} m/s

21. Which of the following illustrates Ohm's Law?

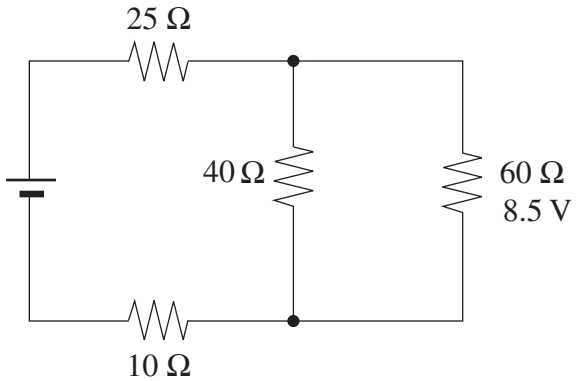
A. 

B. 

C. 

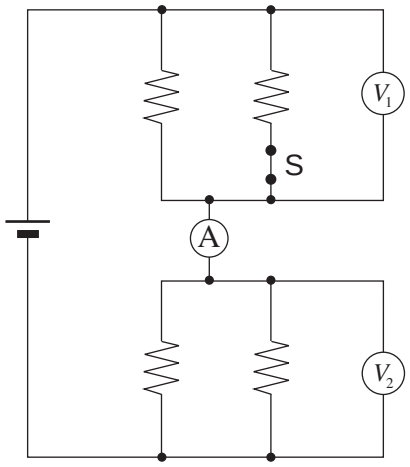
D. 

22. What is the total power dissipated by the four resistors in the diagram below?



A. 1.7 W
B. 2.7 W
C. 4.7 W
D. 7.4 W

23. The circuit and meters are connected as shown with the switch S closed.

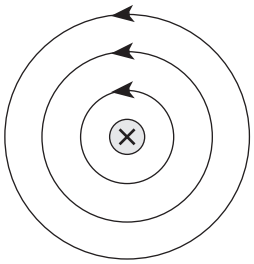


If the switch is then opened, what effects will be observed in the readings of the three meters? (All resistors have the same value.)

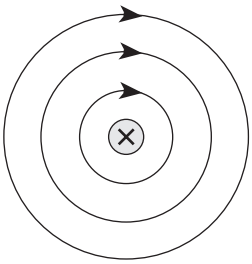
	V_1	V_2	A
A.	decreased	no change	decreased
B.	decreased	increased	decreased
C.	increased	decreased	increased
D.	increased	decreased	decreased

24. Which one of the following diagrams best illustrates the magnetic field produced by a current-carrying wire?

A.

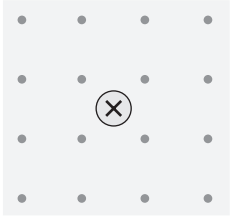


B.



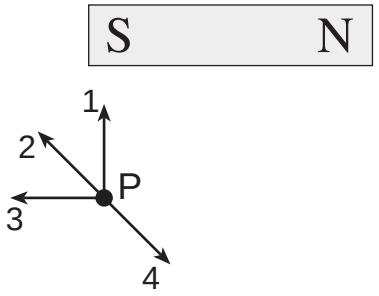
C.

D.



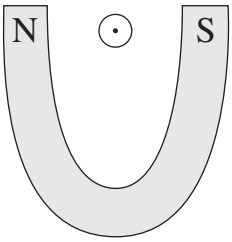
OVER

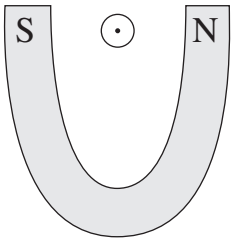
25. What is the direction of the magnetic field at point P due to the bar magnet?

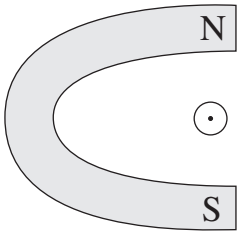


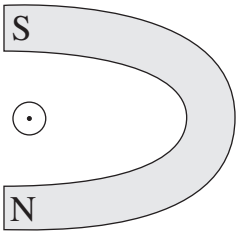
A. 1
B. 2
C. 3
D. 4

26. The diagrams below each illustrate a magnet and a conductor. In each case, the current in the conductor is out of the page. In which of these situations will there be a force on the conductor that points toward the top of the page?

A. 

B. 

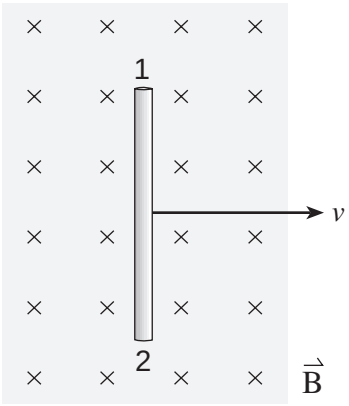
C. 

D. 

27. A positively charged object $\left(q = 1.6\times10^{-19}\ \text{C}\right)$ is travelling at $1.9\times10^{4}\ \text{m/s}$ perpendicular to a $1.0\times10^{-3}\ \text{T}$ magnetic field. If the radius of the resulting path is 0.40 m, what is the object's mass?

A. 3.4×10^{-27} kg
B. 3.1×10^{-19} kg
C. 2.1×10^{-9} kg
D. 0.77 kg

28. A conducting rod of length 0.25 m is moved to the right at 6.0 m/s as shown in the diagram. The induced emf is 3.0 V.



What is the magnitude of the magnetic field and which end of the conducting rod, 1 or 2, becomes positively charged?

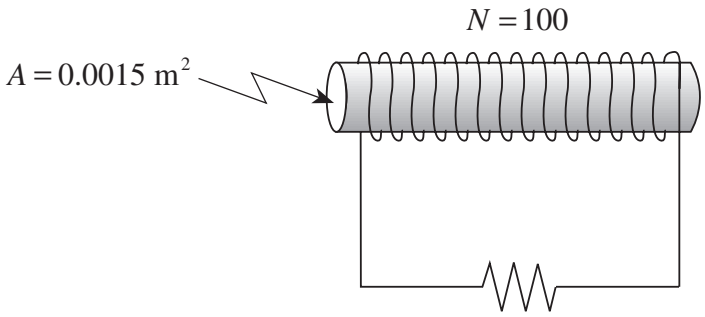
	MAGNETIC FIELD	POSITIVELY CHARGED END
A.	1.50 T	1
B.	1.50 T	2
C.	2.0 T	1
D.	2.0 T	2

29. A coil consisting of 50 loops of radius 4.0×10^{-2} m is placed with its plane perpendicular to a magnetic field that is increasing at a rate of $0.20\ \text{T/s}$. What is the magnitude of the emf induced in the coil?

A. 0.0010 V
B. 0.050 V
C. 0.40 V
D. 1.3 V

OVER

30. One hundred turns of wire are wrapped around an iron core with a cross-sectional area of $0.0015\ \text{m}^2$. The ends of the wire are connected to a resistor producing a circuit with a total resistance of $10.0\ \Omega$.



If the magnetic field in the iron core changes from 3.0 T towards the left to 1.0 T towards the right, how much charge flows in the circuit?

A. 0.030 C
B. 0.060 C
C. 0.30 C
D. 0.60 C

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

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.

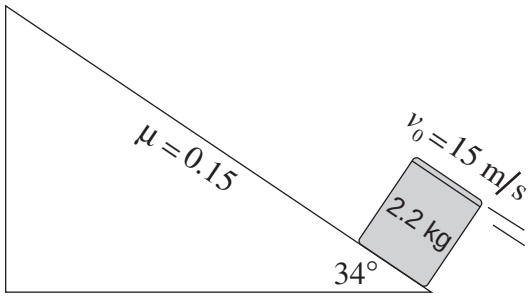
3. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution.

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.**

OVER

1. A 2.2 kg can of paint is projected up an inclined plane with an initial velocity of 15 m/s as shown below.



a) Determine the magnitude of the force due to friction which acts on the paint can as it slides up the incline. **(2 marks)**

ANSWER:

a) magnitude of the force:

_____

b) Determine the magnitude of the net force on the paint can as it slides up the incline.

(3 marks)

ANSWER:

b) magnitude of net force: _____

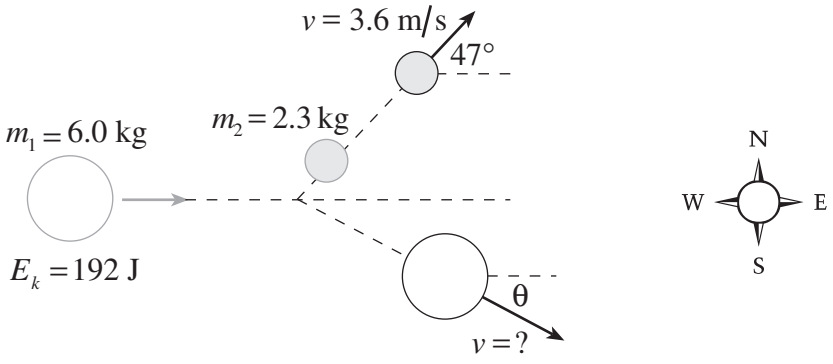
c) Determine how far the paint can slides up the incline before stopping. **(2 marks)**

ANSWER:

c) distance: _____

OVER

2. A 6.0 kg ball having a kinetic energy of 192 J was travelling due east when it underwent an oblique collision with a stationary 2.3 kg ball. The 2.3 kg ball travelled at 3.6 m/s at an angle of 47° north of east after the collision.



(Diagram not to scale.)

What was the velocity (magnitude and direction) of the 6.0 kg ball after the collision?

(7 marks)

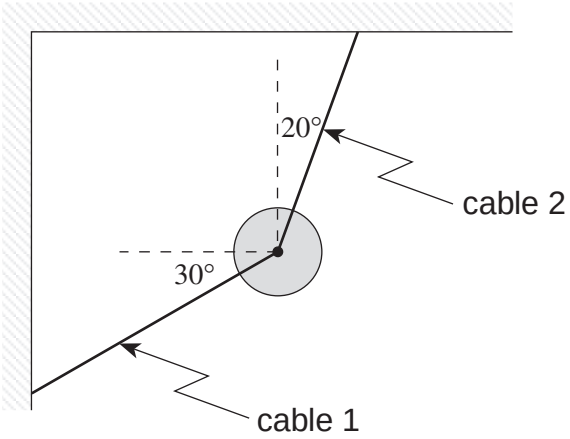
ANSWER:

magnitude of velocity: _____

direction of velocity: _____

OVER

3. A wrecking ball is suspended by two cables as shown below. If the tension in cable 2 is 12 000 N, what is the weight of the wrecking ball? **(7 marks)**

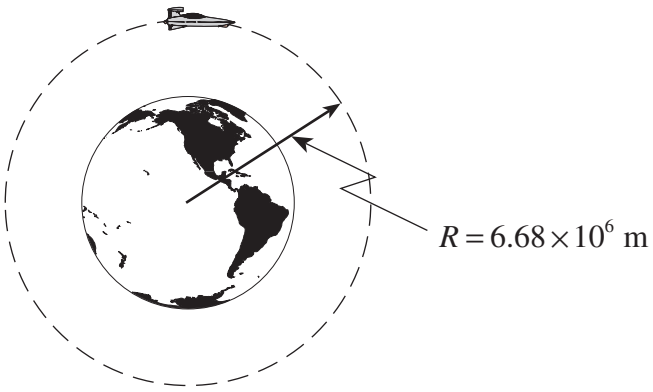


ANSWER:

weight: _____

OVER

4. A 3.2×10^4 kg spacecraft is in a circular orbit of radius 6.68×10^6 m around the earth.

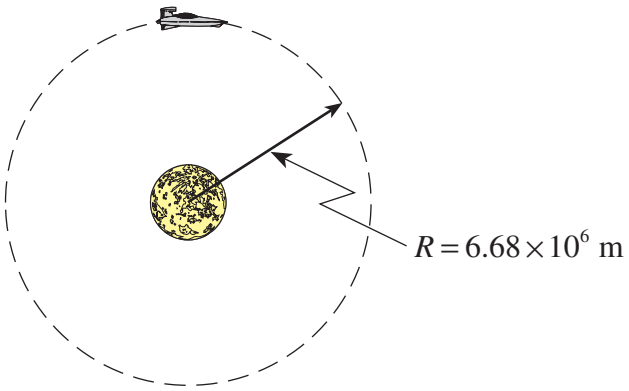


a) Calculate the period of this spacecraft. **(5 marks)**

ANSWER:

period: _____

b) If this spacecraft is then placed into an orbit of the same radius around the moon,



explain how and why the period of this spacecraft would be different than when it was orbiting the earth. **(4 marks)**

_____

_____

_____

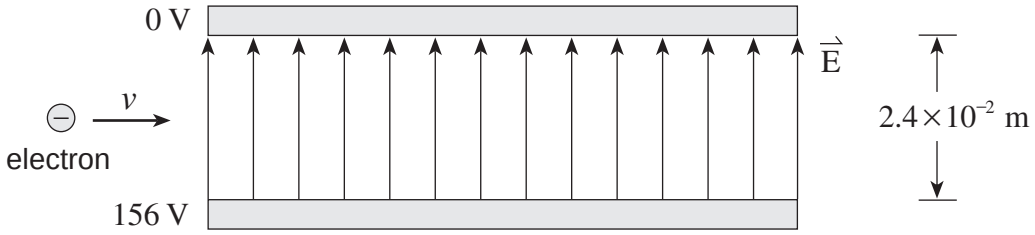
_____

_____

_____

OVER

5. An electron with a speed of $3.3\times10^{7}\ \mathrm{m/s}$ is directed between charged parallel plates as shown.



a) What are the magnitude and direction of the electrostatic force on the electron while it is between the plates? **(5 marks)**

ANSWER:

a) magnitude of electrostatic force: _____

direction of electrostatic force: _____

b) What is the magnitude of the acceleration of the electron while it is between the plates?

(2 marks)

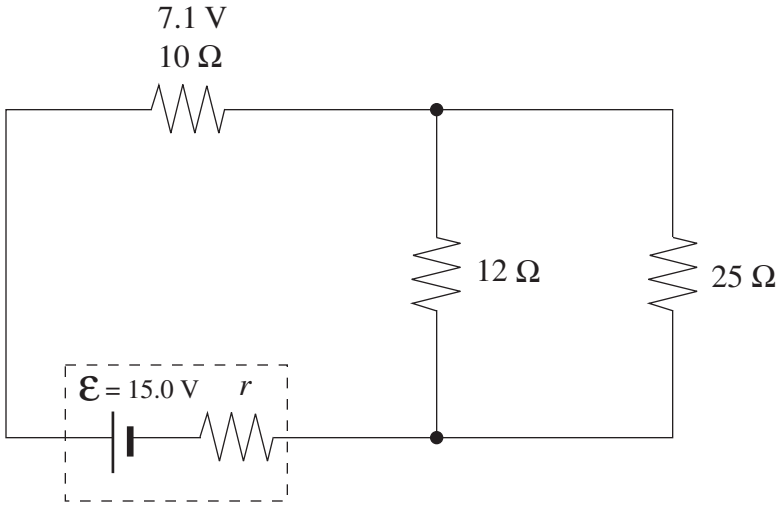
ANSWER:

b) magnitude of the acceleration of the electron:

_____

OVER

6. The potential difference across the 10 Ω resistor is 7.1 V.



a) What is the power dissipated by the 25 Ω resistor? **(4 marks)**

ANSWER:

a) power dissipated: _____

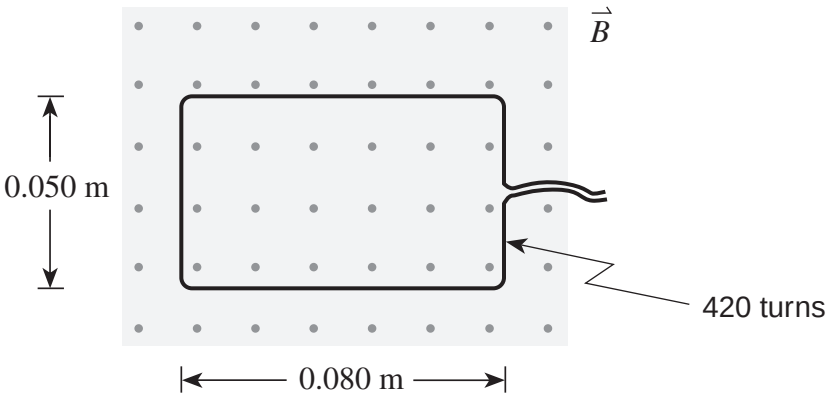
b) What is the internal resistance of the battery? **(3 marks)**

ANSWER:

b) internal resistance: _____

OVER

7. A 420-turn rectangular coil is positioned as shown in a 0.14 T magnetic field.



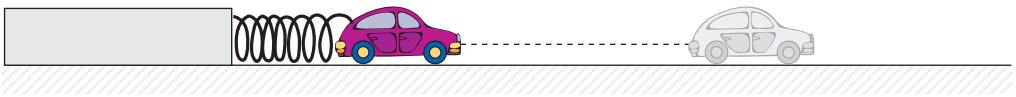
The magnetic field strength is increased over a 0.20 s interval, inducing an average emf of 1.8 V in the coil. What is the final magnetic field strength? **(7 marks)**

ANSWER:

magnetic field strength: _____

OVER

8. A small toy car is placed in a spring-loaded launcher.

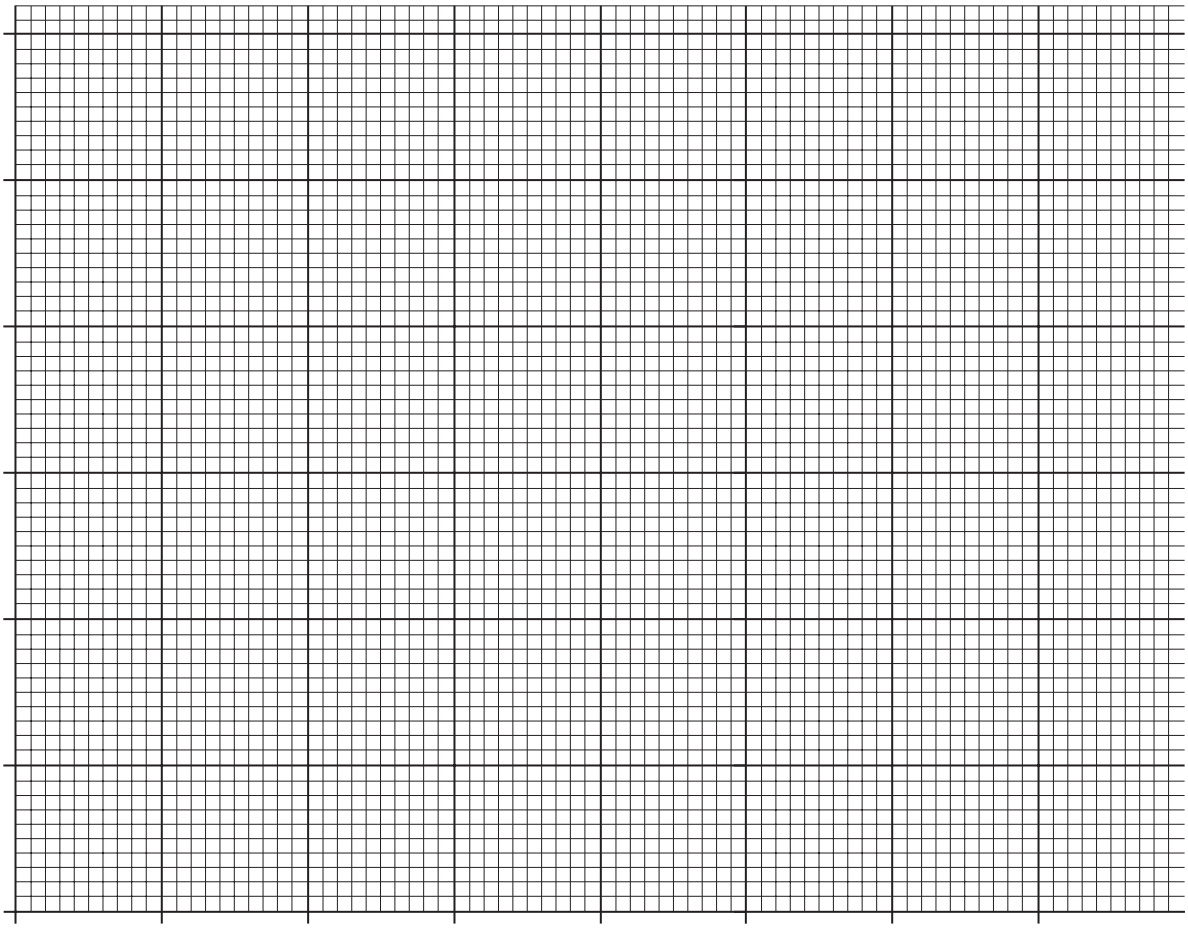


The force needed to compress the spring is recorded as a function of distance.

a) Plot a graph of force vs. distance using the data table shown. **(2 marks)**

Force (N)	Distance (m)
7.5	0.020
13.2	0.035
14.8	0.040
19.1	0.050
23.0	0.060
29.5	0.080

Force (N)



Distance (m)

b) Calculate the area under this graph from distance = 0.0 m to distance = 0.080 m. **(2 marks)**

ANSWER:

area: _____

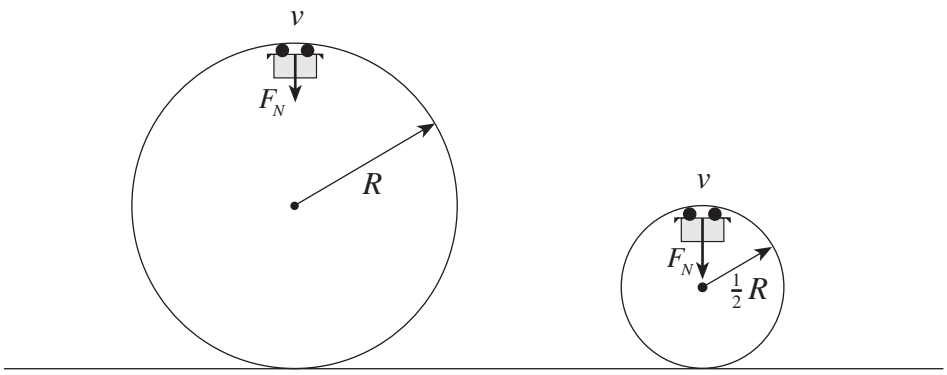
c) What does this area represent? **(1 mark)**

_____

_____

OVER

9. During a roller coaster ride, the riders move through two loops, the second being one-half the radius of the first. The riders, however, travel at the same speed at the top of each of these two loops.



Using principles of physics, explain why the riders would experience a greater normal force at the top of the second smaller loop than at the top of the first, larger loop. **(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	μ_o	$= 4\pi \times 10^{-7}\ \text{T} \cdot \text{m/A}$
Speed of light	c	$= 3.00 \times 10^{8}\ \text{m/s}$

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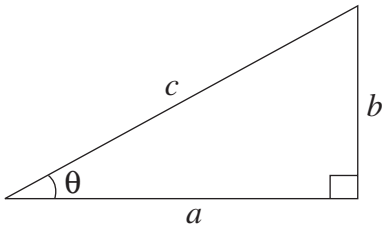
For Right-angled Triangles:

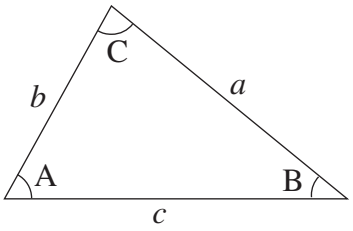


$$a^2 + b^2 = c^2$$

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

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

For All Triangles:



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

$$\sin 2\text{A} = 2\sin\text{A}\cos\text{A}$$

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

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

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:

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

Vector Kinematics in Two Dimensions:

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

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

Vector Dynamics:

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

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

Work, Energy, and Power:

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

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

Momentum:

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

Equilibrium:

$$\tau = Fd$$

Circular Motion:

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

Gravitation:

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

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Exercise care when tearing along perforations.

Electrostatics:

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

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

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

Electric Circuits:

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

$$V_{\mathrm{terminal}} = \mathcal{E} \pm Ir \qquad P = IV$$

Electromagnetism:

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

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

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

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

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

ROUGH WORK FOR MULTIPLE-CHOICE

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