INSERT STUDENT I.D. NUMBER (PEN)

STICKER IN THIS SPACE

JUNE 1999

PROVINCIAL EXAMINATION

MINISTRY OF EDUCATION

PHYSICS 12

GENERAL INSTRUCTIONS

1. Insert the stickers with your Student I.D. Number (PEN) in the allotted spaces above and on the **back** cover of this booklet. **Under no circumstance is your name or identification, other than your Student I.D. 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. 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.

5. For each of the written-response questions, write your answer in the space provided in this booklet.

6. 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.

7. 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.

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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	60
	PART B:	9 written-response questions	60	60
		Total:	**120 marks**	**120 minutes**

2. Aside from an approved calculator, electronic devices, including dictionaries and pagers, are **not** permitted in the examination room.

3. 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.

4. 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.

5. **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 also include graphing functions. Computers, calculators with a QWERTY keyboard, and electronic writing pads will not be allowed. Students must not bring any external devices to support calculators such as manuals, printed or electronic cards, printers, memory expansion chips or cards, or external keyboards. Students may have more than one calculator available during the examination. 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.

6. 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.

7. 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.

8. The time allotted for this examination is **two hours**.

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PART A: MULTIPLE CHOICE

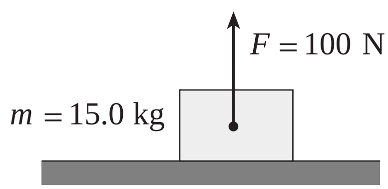
Value: 60 marks (2 marks per question) **Suggested Time: 60 minutes**

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 a correct unit for gravitational field strength?

   A. N
   B. N/C
   C. N/kg
   D. $N \cdot m$

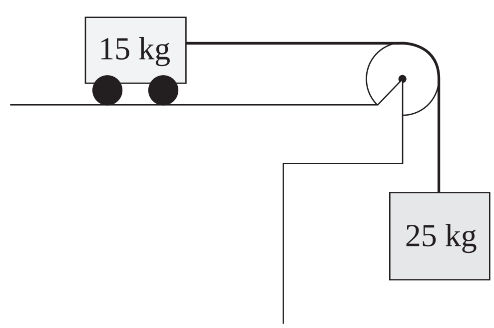
2. A 15 kg block on a horizontal surface has a 100 N force acting on it as shown.



   What is the normal force?

   A. 47 N
   B. 100 N
   C. 147 N
   D. 247 N

3. A 15 kg cart is attached to a hanging 25 kg mass. Friction is negligible.

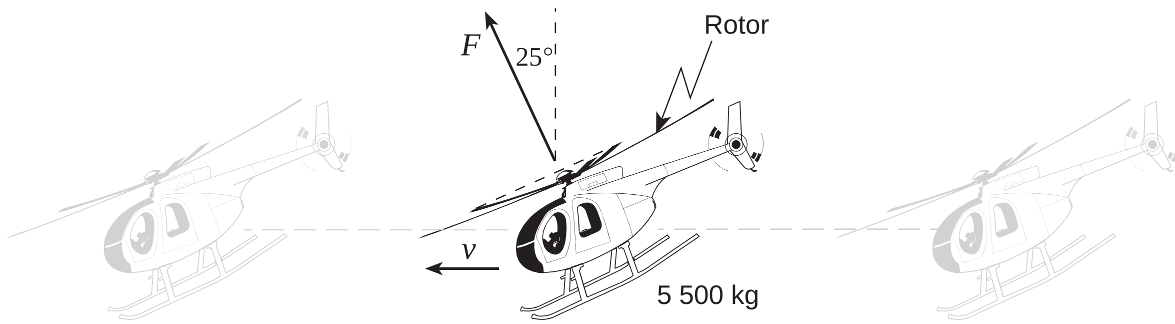


   What is the acceleration of the 15 kg cart?

   A. 2.5 m/s^2
   B. 6.1 m/s^2
   C. 6.5 m/s^2
   D. 16 m/s^2

OVER

4. A 5 500 kg helicopter is travelling at constant speed in level flight.



What is the force F provided by the rotor?

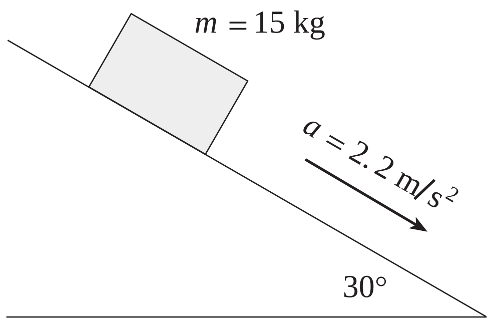
A. 4.9×10^{4} N

B. 5.4×10^{4} N

C. 5.9×10^{4} N

D. 1.2×10^{5} N

5. A 15 kg block has a constant acceleration of $2.2\ \mathrm{m/s^2}$ down a $30°$ incline.



What is the magnitude of the friction force on the block?

A. 33 N
B. 41 N
C. 74 N
D. 130 N

6. A satellite is in a stable orbit around the earth at a constant altitude. Its gravitational potential energy is -1.5×10^{10} J. How much work is done on the satellite during one orbit?

A. -1.5×10^{10} J

B. 0 J

C. 7.5×10^{9} J

D. 1.5×10^{10} J

7. Which of the following correctly describes momentum and impulse?

	MOMENTUM	IMPULSE
A.	vector	vector
B.	vector	scalar
C.	scalar	vector
D.	scalar	scalar

8. A stationary object explodes into two fragments. A $4.0\ \text{kg}$ fragment moves westwards at $3.0\ \text{m/s}$. What are the speed and kinetic energy of the remaining $2.0\ \text{kg}$ fragment?

	SPEED	KINETIC ENERGY
A.	$4.2\ \text{m/s}$	18 J
B.	$4.2\ \text{m/s}$	36 J
C.	$6.0\ \text{m/s}$	18 J
D.	$6.0\ \text{m/s}$	36 J

9. A $1\,000\ \text{kg}$ vehicle travelling westward at $15\ \text{m/s}$ is subjected to a $1.0\times10^{4}\ \text{N}\cdot\text{s}$ impulse northward. What is the magnitude of the final momentum of the vehicle?

A. $5.0\times10^{3}\ \text{kg}\cdot\text{m/s}$

B. $1.5\times10^{4}\ \text{kg}\cdot\text{m/s}$

C. $1.8\times10^{4}\ \text{kg}\cdot\text{m/s}$

D. $2.5\times10^{4}\ \text{kg}\cdot\text{m/s}$

10. A body is in static equilibrium when

A. $\Sigma\tau = 0$ only.

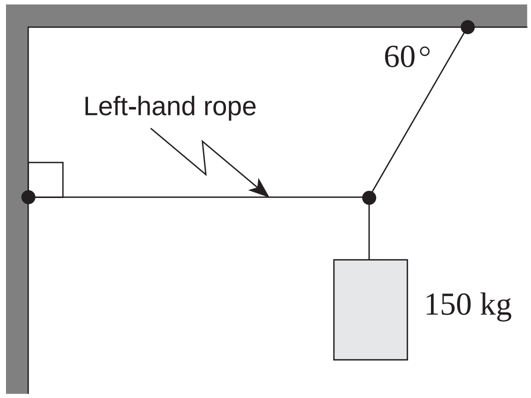
B. $\Sigma F = 0$ only.

C. $\Sigma F = 0$ and $\Sigma\tau = 0$.

D. $\Sigma F = 0$ and $\Sigma\tau \neq 0$.

OVER

11. A 150 kg object is suspended from a ceiling and attached to a wall. What is the tension in the left-hand rope?



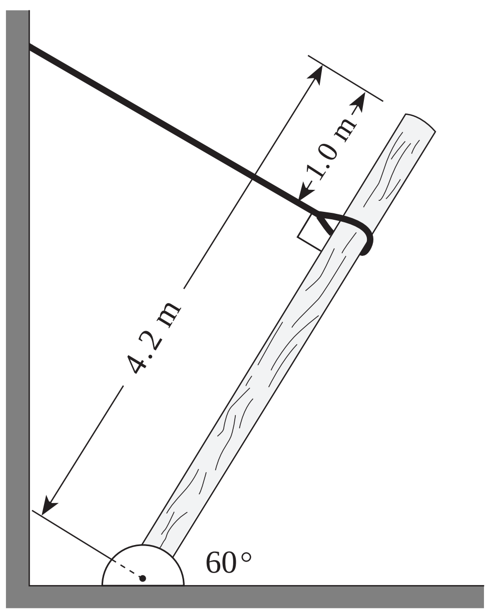
A. 7.4×10^{2} N

B. 8.5×10^{2} N

C. 1.3×10^{3} N

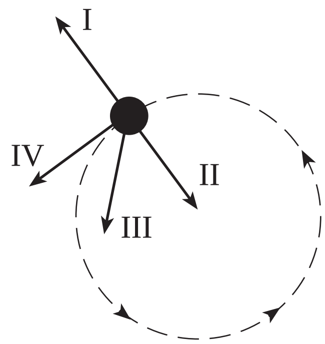
D. 2.5×10^{3} N

12. A 4.2 m long uniform post is supported by a cable having a tension of $1\,700\text{ N}$. What is the mass of this post?



A. 160 kg
B. 260 kg
C. 300 kg
D. 530 kg

13. A satellite moves in a circular path at a constant speed. Which vector in the diagram below best represents the satellite's acceleration?



A. I
B. II
C. III
D. IV

14. A 2.5 kg object moves at a constant speed of 8.0 m/s in a 5.0 m radius circle. What is the object's acceleration?

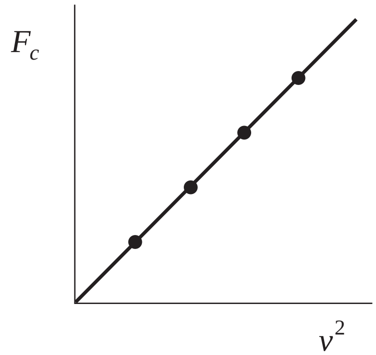
A. 0 m/s^2
B. 1.6 m/s^2
C. 13 m/s^2
D. 32 m/s^2

15. What is the magnitude of Earth's centripetal acceleration as it orbits the Sun?

A. $1.9\times10^{-10}\text{ m/s}^2$
B. $4.2\times10^{-4}\text{ m/s}^2$
C. $5.9\times10^{-3}\text{ m/s}^2$
D. 9.8 m/s^2

OVER

16. A student plots a graph of centripetal force F_c versus the square of velocity v^2 for an object in uniform circular motion.



What is the slope of this graph?

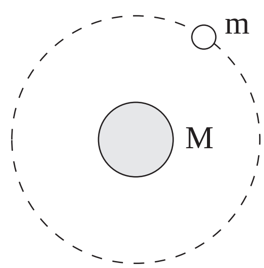
A. $\dfrac{m}{r}$

B. $\dfrac{r}{m}$

C. $\dfrac{4\pi^2 r}{T^2}$

D. $\dfrac{T^2}{4\pi^2 r}$

17. Which of the following is a correct expression for the total energy of the orbiting satellite shown below?



A. $E_T = -G\dfrac{Mm}{r}$

B. $E_T = G\dfrac{Mm}{r}$

C. $E_T = \dfrac{1}{2}mv^2 + mgr$

D. $E_T = \dfrac{1}{2}mv^2 + \left(-G\dfrac{Mm}{r}\right)$

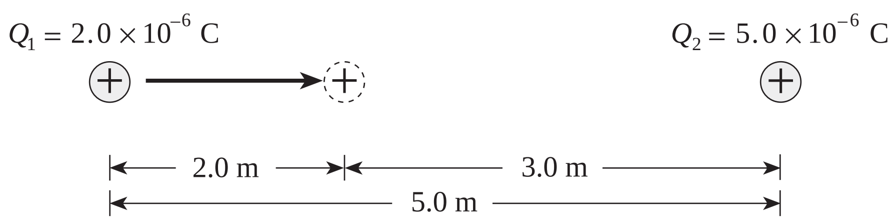
18. A satellite orbits Earth at a velocity of 3.1×10^{3} m/s. What is the radius of this orbit?

A. 9.7×10^{3} m
B. 6.4×10^{6} m
C. 4.2×10^{7} m
D. 8.3×10^{7} m

19. In a cathode ray tube,

A. protons are accelerated from anode (positive) to cathode (negative).
B. protons are accelerated from cathode (negative) to anode (positive).
C. electrons are accelerated from anode (positive) to cathode (negative).
D. electrons are accelerated from cathode (negative) to anode (positive).

20. Charge Q_1 is located 5.0 m from charge Q_2 as shown.



How much work must be done to move charge Q_1 2.0 m closer to charge Q_2?

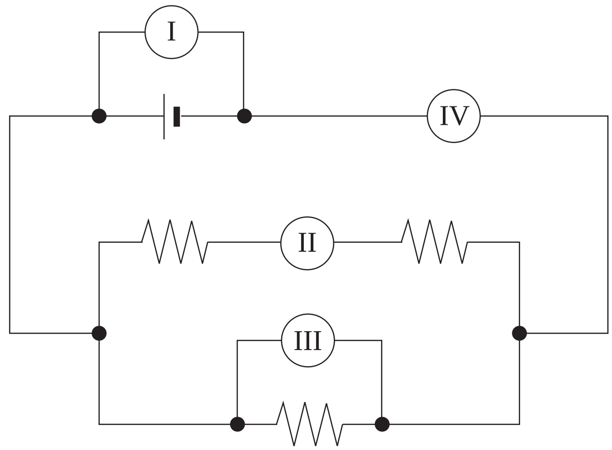
A. 7.2×10^{-3} J
B. 1.1×10^{-2} J
C. 1.2×10^{-2} J
D. 2.0×10^{-2} J

21. An electron orbits the nucleus of an atom with velocity v. If this electron were to orbit the same nucleus with twice the previous orbital radius, its orbital velocity would now be

A. $\dfrac{v}{2}$
B. $\dfrac{v}{\sqrt{2}}$
C. v
D. $2v$

OVER

22. The circuit shown below includes two ammeters and two voltmeters. Identify the correct placement of these meters.

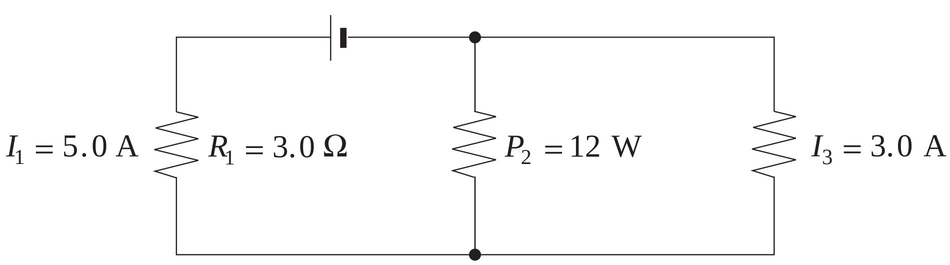


	AMMETERS	VOLTMETERS
A.	I, II	III, IV
B.	I, III	II, IV
C.	II, IV	I, III
D.	III, IV	I, II

23. A 120 V supply is connected to a heater of resistance 15 Ω. What must the resistance of another heater be in order to produce the same power output when connected to a 240 V supply?

A. 3.8 Ω
B. 7.5 Ω
C. 30 Ω
D. 60 Ω

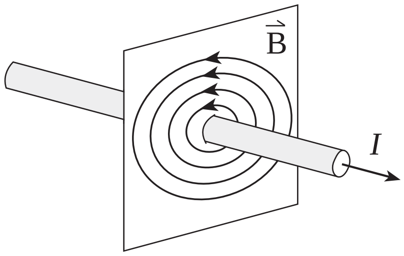
24. What is the voltage of the power supply shown in the diagram?



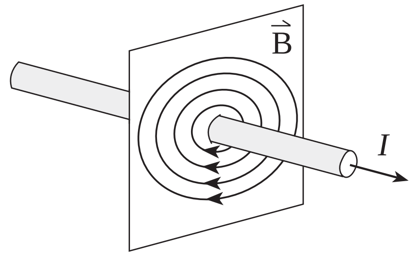
A. 12 V
B. 19 V
C. 21 V
D. 27 V

25. Which of the following diagrams best shows the magnetic field due to a long straight wire carrying a conventional current I as shown?

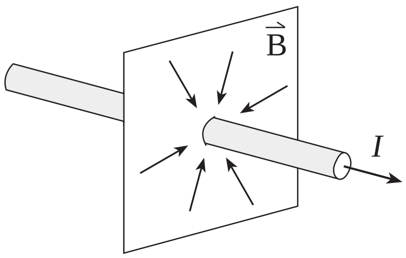
A.



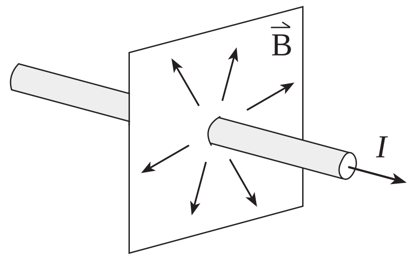
B.



C.



D.



26. A proton is travelling at 2.3×10^{6} m/s in a circular path in a 0.75 T magnetic field. What is the magnitude of the force on the proton?

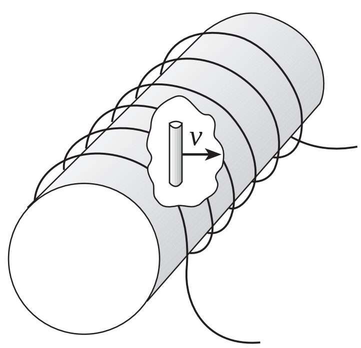
A. 1.6×10^{-24} N

B. 2.9×10^{-21} N

C. 2.8×10^{-13} N

D. 1.7 N

27. A solenoid of length 0.75 m has a radius 0.092 m. A current of 25 A flows through its 4 700 turns. Within this solenoid a 0.10 m long conductor moves at 4.3 m/s perpendicular to the field in the solenoid.



What emf is induced between the ends of the conductor?

A. 0.085 V

B. 0.197 V

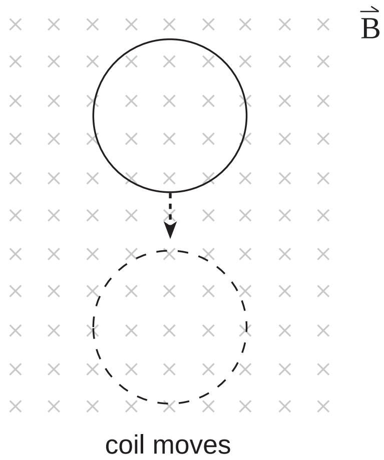
C. 0.430 V

D. 4.80 V

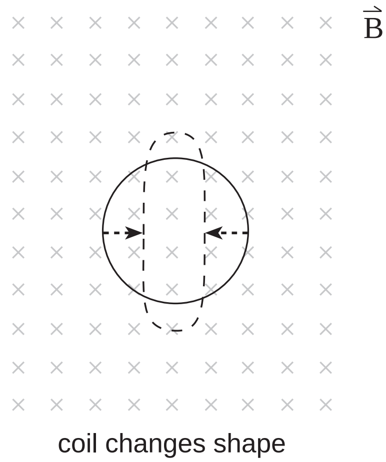
OVER

28. In which of the following situations would the greatest emf be induced in the coil? All changes occur in the same time interval.

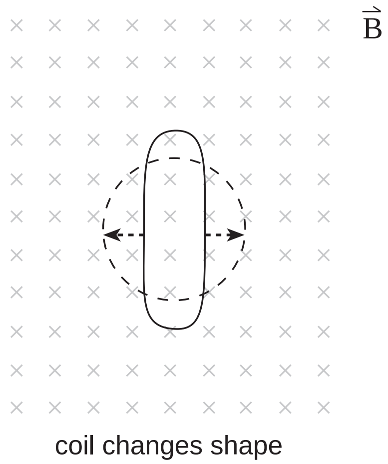
A.



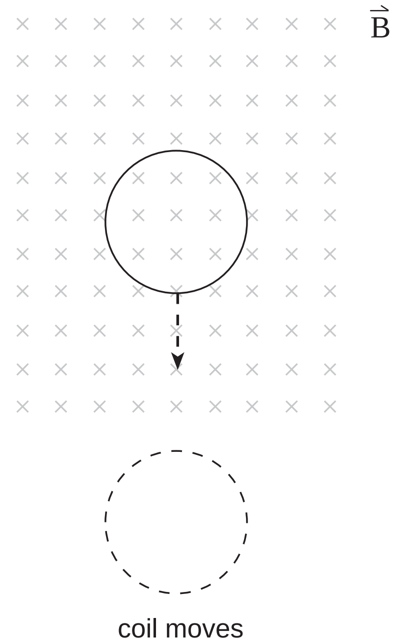
B.



C.



D.



29. A motor is connected to a 12 V dc supply and draws 5.0 A when it first starts up. What will be the back emf when the motor is operating at full speed and drawing 1.2 A?

A. 7.0 V
B. 7.8 V
C. 9.1 V
D. 10.8 V

30. An ideal transformer has a potential difference of 130 V ac across the primary windings and a potential difference of 780 V ac across the secondary windings. There are 390 turns in the secondary. The secondary current is

A. twice the primary current.
B. one half the primary current.
C. six times the primary current.
D. one-sixth the primary current.

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.

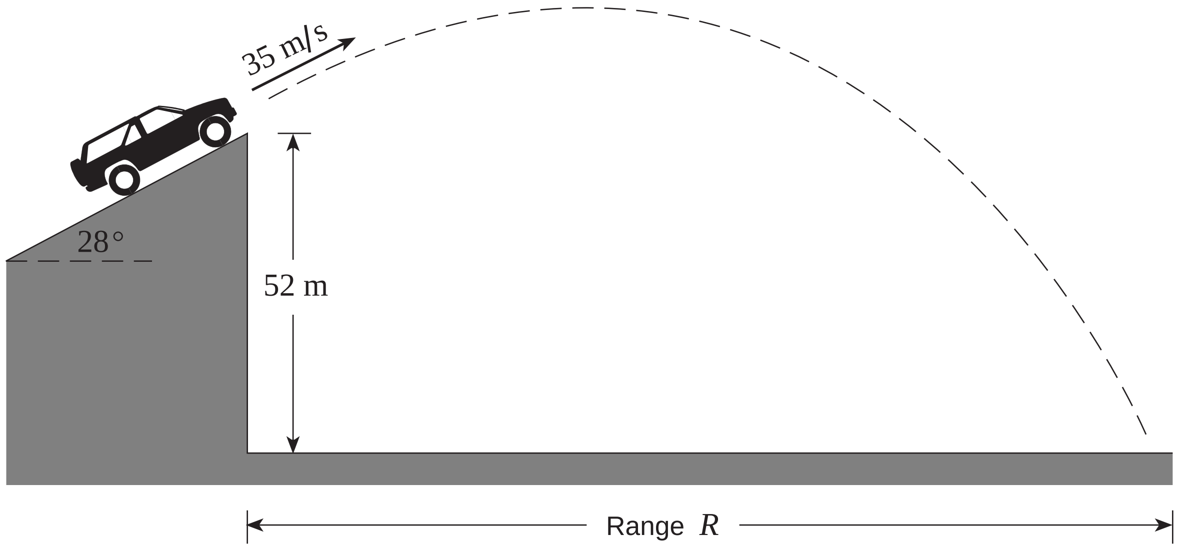
3. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution.

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.**

OVER

1. A stunt vehicle leaves an incline with a speed of $35\ \text{m/s}$ at a height of $52\ \text{m}$ above level ground. Air resistance is negligible.



a) What are the vehicle's vertical and horizontal velocity components as it leaves the incline?

(1 mark)

b) What is the vehicle's time of flight? **(4 marks)**

c) What is the vehicle's range, R ? **(2 marks)**

ANSWER:

a) vertical velocity: ____________________

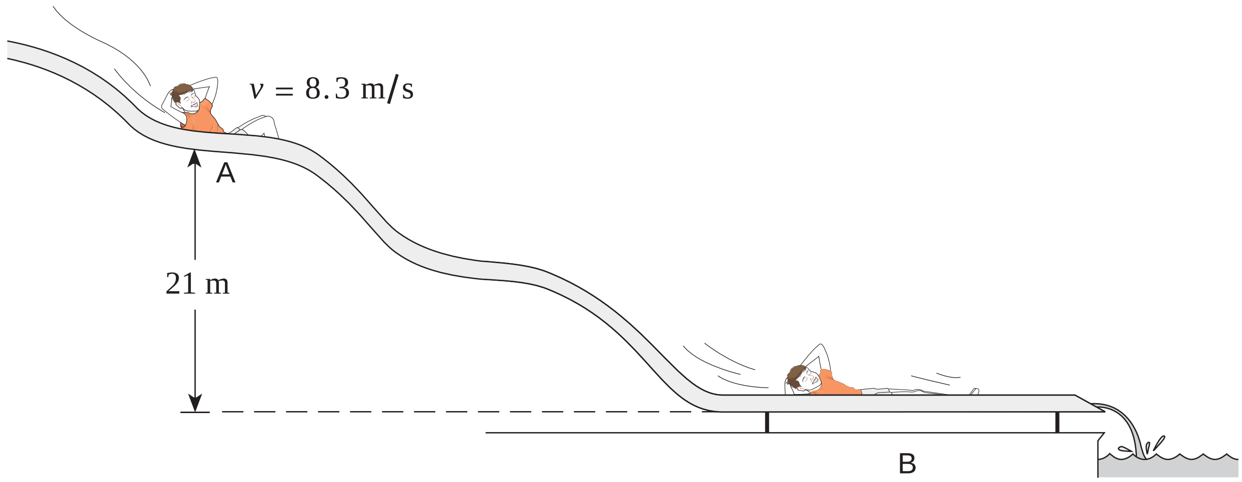
horizontal velocity: ____________________

b) time: ____________________

c) range: ____________________

OVER

2. A 45 kg child on a water slide passes point A at $8.3\ \text{m/s}$.



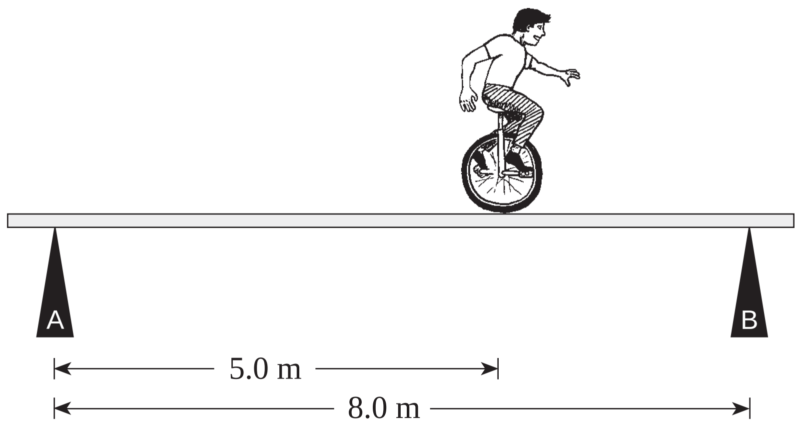
As the child descends from A to B, 3 600 J of heat energy is created because of friction. What is his speed at B? **(7 marks)**

ANSWER:

speed: ______________________________

OVER

3. A circus performer on a unicycle of total mass 55 kg rides across a uniform 30 kg beam. The supports are placed equal distances from the ends of the beam.



a) When he is at the position shown, determine the forces exerted by the supports on the beam. **(5 marks)**

b) As the performer moves toward the right the force exerted by support B will

- ❐ remain the same.
- ❐ increase.
- ❐ decrease.

(Check one response.) **(1 mark)**

c) Using principles of physics, explain your answer to b). **(3 marks)**

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ANSWER:
a) force A: ______________________
force B: ______________________

OVER

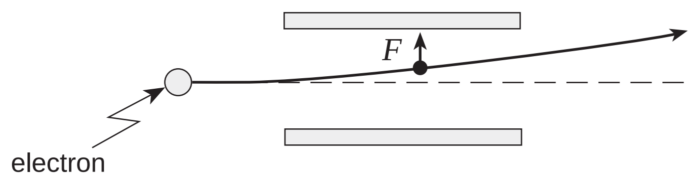
4. A 1 500 kg satellite travels in a stable circular orbit around the earth. The orbital radius is 4.2×10^7 m. What is the satellite's kinetic energy? **(7 marks)**

ANSWER:

kinetic energy: ______________________________

OVER

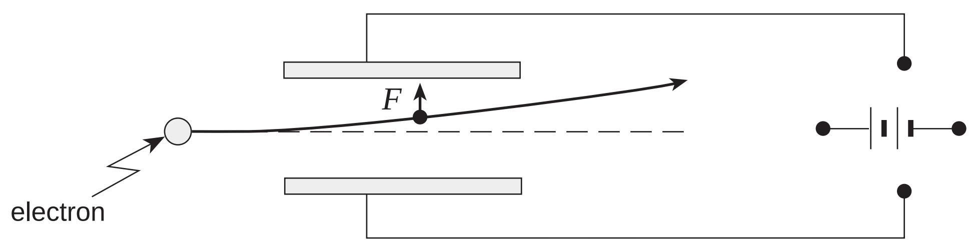
5. An electron passing between parallel plates $0.025\ \text{m}$ apart experiences an upward electrostatic force of $5.1\times10^{-16}\ \text{N}$.



a) What is the magnitude of the electric field between the plates? **(3 marks)**

b) What is the potential difference between the plates? **(2 marks)**

c) On the diagram below draw in the connections to the power supply necessary for the electron to experience this upward force. **(2 marks)**



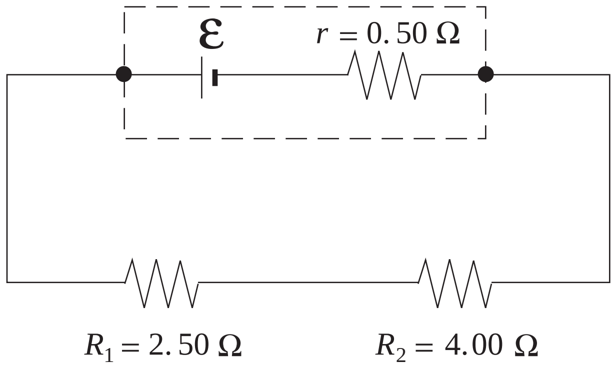
ANSWER:

a) electric field: ____________________

b) potential difference: ____________________

OVER

6. The cell shown in the diagram supplies a $1.80\ \text{A}$ current to the resistors R_1 and R_2.



a) What is the terminal voltage of the cell? **(3 marks)**

b) What is the emf of the cell? **(4 marks)**

ANSWER:

a) terminal voltage: ______________________

b) emf: __________________________________

OVER

7. A rectangular coil of wire containing 250 loops is placed in a magnetic field. Each loop measures 0.075 m by 0.28 m. The magnetic field changes over a time interval of 0.36 s producing an average emf of 1.3 V. What is the change in the magnetic field strength?

(7 marks)

ANSWER:

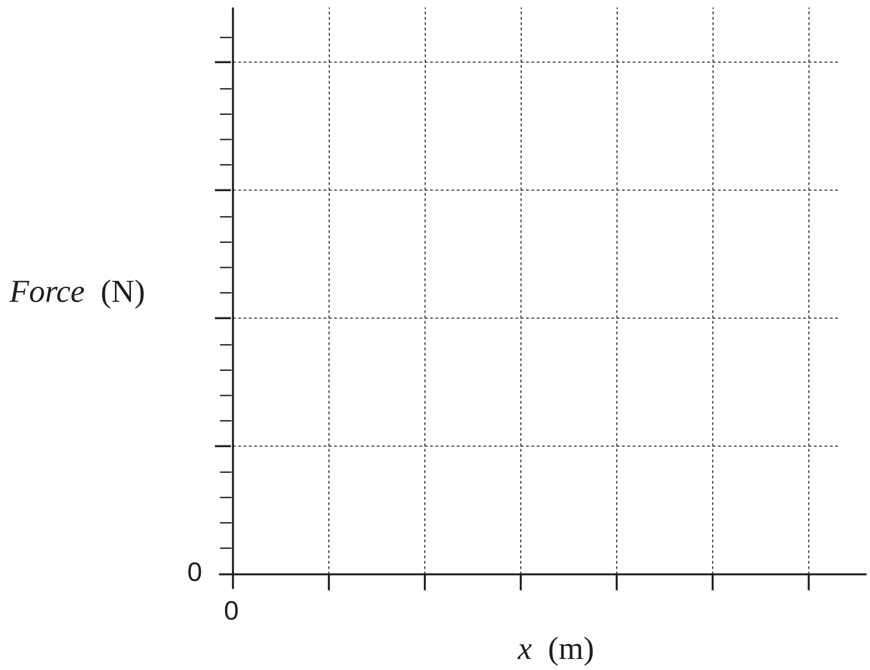
change in field strength: ___________________

OVER

8. A daredevil is attached by his ankles to a bungee cord and drops from the top of a bridge. The force exerted on the daredevil by the bungee cord is measured against the change in length, x, of the cord as the cord is stretched, slowing the daredevil's fall.

Force (N)	0	300	600	1 000	1 200	1 700	1 900
x (m)	0	5	10	15	20	25	30

a) Plot a graph of force vs. change in length on the graph below. **(2 marks)**



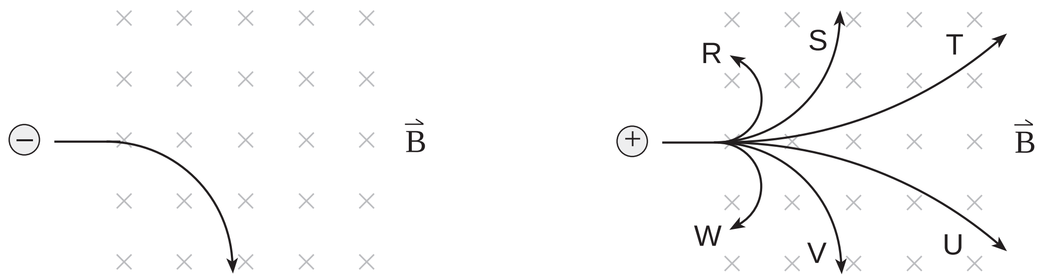
b) Use the graph to determine the work done by the bungee cord during its stretch. **(3 marks)**

ANSWER:

b) work: ______________________________

OVER

9. An electron travelling at a high speed enters a magnetic field as shown. A proton travelling at the same speed then enters the magnetic field.



a) Which of the six choices best illustrates the path the proton will follow? **(1 mark)**

____

b) Using principles of physics, explain why the proton takes the path selected in a). **(3 marks)**

____

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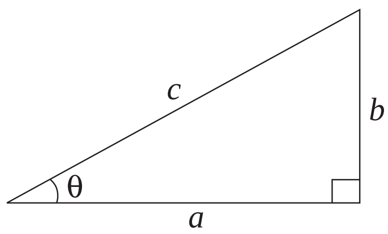
END OF EXAMINATION

TABLE OF CONSTANTS

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

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

For Right-angled Triangles:

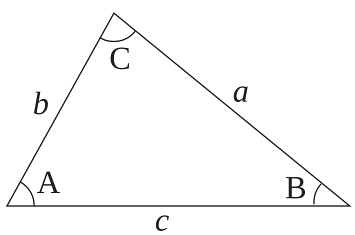


$$a^2 + b^2 = c^2$$

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

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

For All Triangles:



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

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

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

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

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:

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

Vector Kinematics in Two Dimensions:

$v = v_0 + at$ $\bar{v} = \dfrac{v + v_0}{2}$

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

Vector Dynamics:

$F_{\mathrm{net}} = ma$ $F_{\mathrm{g}} = mg$

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

Work, Energy, and Power:

$W = Fd$ $E_{\mathrm{p}} = mgh$

$E_{\mathrm{k}} = \dfrac{1}{2}mv^2$ $P = \dfrac{W}{t}$

Momentum:

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

Equilibrium:

$\tau = Fd$

Circular Motion:

$a_{\mathrm{c}} = \dfrac{v^2}{r} = \dfrac{4\pi^2 r}{T^2}$

Gravitation:

$F = G\dfrac{m_1 m_2}{r^2}$ $E_{\mathrm{p}} = -G\dfrac{m_1 m_2}{r}$

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Electrostatics:

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

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

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

Electric Circuits:

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

$$V_{\text{terminal}} = \varepsilon \pm Ir \qquad P = IV$$

Electromagnetism:

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

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

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

$$V_{\text{back}} = \varepsilon - Ir$$

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

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

ROUGH WORK FOR MULTIPLE-CHOICE

INSERT STUDENT I.D. NUMBER (PEN)

STICKER IN THIS SPACE

PHYSICS 12

June 1999

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PHYSICS 12

June 1999

Course Code = PH

Score for Question 1:	Score for Question 8:
1. ______ (7)	8. ______ (5)

Score for Question 2:	Score for Question 9:
2. ______ (7)	9. ______ (4)

Score for Question 3:
3. ______ (9)

Score for Question 4:
4. ______ (7)

Score for Question 5:
5. ______ (7)

Score for Question 6:
6. ______ (7)

Score for Question 7:
7. ______ (7)