INSERT STUDENT I.D. NUMBER (PEN)

STICKER IN THIS SPACE

AUGUST 1998

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

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. 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. 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 communication between calculators is prohibited during the examination. 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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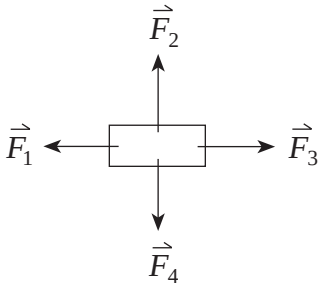
PART A: MULTIPLE CHOICE

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.

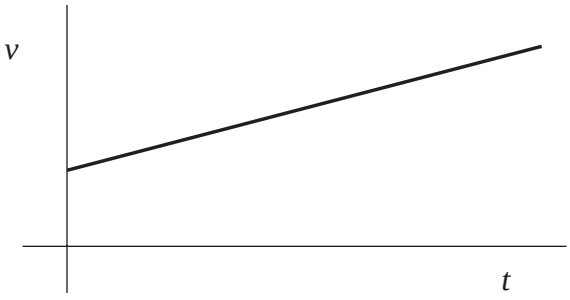
1. The free body diagram shown below represents a crate being dragged towards the **left** over a rough surface.



Which of the vectors represent the normal force and the friction force acting on the crate?

	NORMAL FORCE	FRICTION FORCE
A.	$\vec{F}_1$	$\vec{F}_2$
B.	$\vec{F}_2$	$\vec{F}_3$
C.	$\vec{F}_3$	$\vec{F}_4$
D.	$\vec{F}_4$	$\vec{F}_1$

2. The graph shown below displays velocity v versus time t for a moving object.



The slope of this graph represents the object's

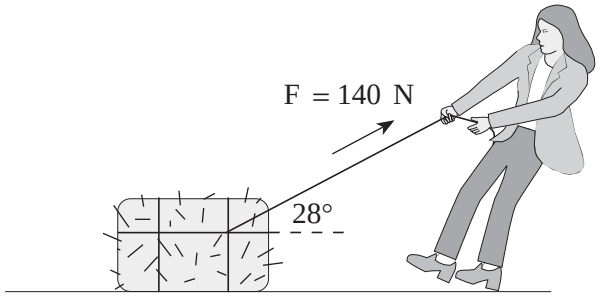
A. mass.
B. momentum.
C. acceleration.
D. displacement.

OVER

3. The gravitational field strength on planet X is 5.0 N/kg. An astronaut of mass 60 kg leaves Earth to visit planet X. What will her mass and weight be when she is on the surface of planet X?

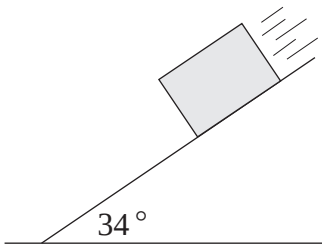
	MASS	WEIGHT
A.	60 kg	300 N
B.	60 kg	590 N
C.	120 kg	300 N
D.	120 kg	590 N

4. A girl applies a 140 N force to a 35 kg bale of hay at an angle of $28°$ above horizontal. The friction force acting on the bale is 55 N. What will be the horizontal acceleration of the bale?



A. 0.31 m/s^2
B. 2.0 m/s^2
C. 2.4 m/s^2
D. 2.6 m/s^2

5. A 5.0 kg concrete block accelerates down a $34°$ slope at 4.2 m/s^2. Find the coefficient of friction between the block and the slope.



A. 0.13
B. 0.16
C. 0.43
D. 0.67

6. What is the minimum power output of a small electric motor that lifts a $0.050\ \text{kg}$ mass through $2.0\ \text{m}$ in $30\ \text{s}$?

   A. $0.0017\ \text{W}$
   B. $0.017\ \text{W}$
   C. $0.033\ \text{W}$
   D. $15\ \text{W}$

7. An object travelling due north experiences an impulse due east. The direction of the change in momentum of this object is

   A. east.
   B. west.
   C. north.
   D. northeast.

8. A $1.5\ \text{kg}$ ball falling vertically strikes the floor with a speed of $12\ \text{m/s}$ and rebounds upward with a speed of $8.0\ \text{m/s}$. What is the magnitude and direction of the impulse given to the ball?

	IMPULSE	DIRECTION
A.	$6.0\ \text{N}\cdot\text{s}$	upward
B.	$6.0\ \text{N}\cdot\text{s}$	downward
C.	$30\ \text{N}\cdot\text{s}$	upward
D.	$30\ \text{N}\cdot\text{s}$	downward

9. A net force of $20\ \text{N}$ acts for $1.5\ \text{s}$ on a $4.0\ \text{kg}$ object initially at rest. What is the final kinetic energy of the object?

   A. $30\ \text{J}$
   B. $110\ \text{J}$
   C. $230\ \text{J}$
   D. $440\ \text{J}$

OVER

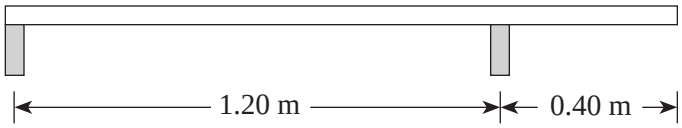
10. A 900 kg car travelling at 12 m/s due east collides with a 600 kg car travelling at 24 m/s due north. As a result of the collision, the two cars lock together and move in what final direction?

A. 45° N of E
B. 53° N of E
C. 63° N of E
D. 69° N of E

11. What are the units of torque?

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

12. A uniform 1.60 m board rests on two bricks as shown below. The left brick exerts an upward force of 12 N on the board.



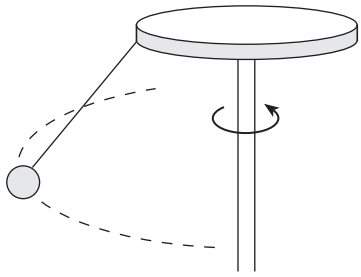
What upward force does the right brick exert?

A. 3.0 N
B. 12 N
C. 24 N
D. 36 N

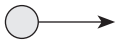
13. An object travels with a constant speed in a circular path. The net force on the object is

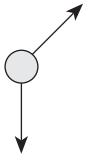
A. zero.
B. towards the centre.
C. away from the centre.
D. tangent to the object's path.

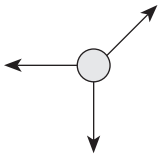
14. An object attached to a rotating table is moving in a circular path with a constant speed.



Which is the correct free body diagram for the object?

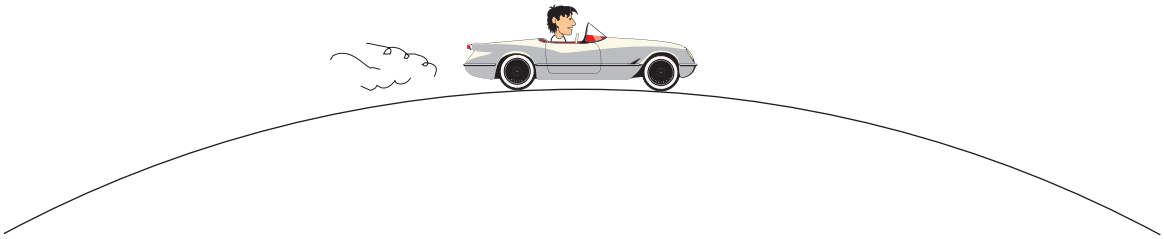
A. 

B. 

C. 

D. 

15. A 65 kg student is in a car travelling at 25 m/s on a hill of radius 110 m. When the car is at the top of the hill, what upward force does the seat exert on the student?



A. 270 N
B. 370 N
C. 640 N
D. 910 N

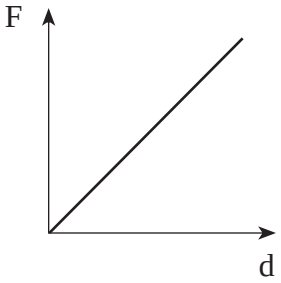
16. A 1 200 kg car can travel without slipping at a maximum speed of 28 m/s in a circular path of radius 70 m on a dry horizontal surface. When it rains, the coefficient of friction is reduced to one half its original value. What is the maximum speed under this wet condition?

A. 7.0 m/s
B. 14 m/s
C. 20 m/s
D. 28 m/s

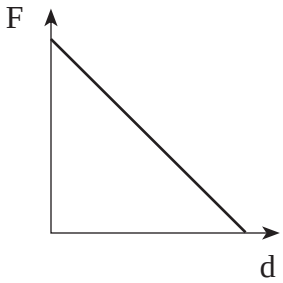
OVER

17. Which of the following graphs shows how the gravitational force varies with the distance of separation between two objects?

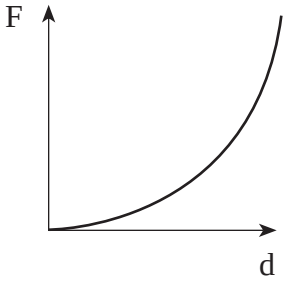
A.



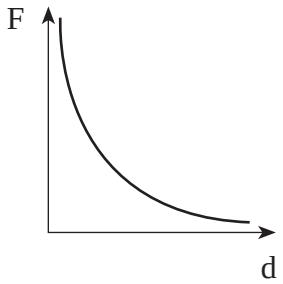
B.



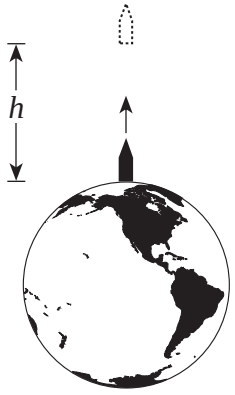
C.



D.

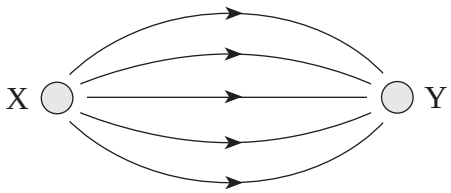


18. A 5.2×10^{4} kg rocket is initially at rest on the surface of the earth. If 3.0×10^{11} J of work is done on this rocket, what maximum altitude h will the rocket reach? (Assume the rocket's mass does not change.)



A. 5.9×10^{5} m
B. 6.5×10^{5} m
C. 5.8×10^{6} m
D. 6.9×10^{7} m

19. Which of the following correctly describes the polarity of the charges X and Y?



	POLARITY OF X	POLARITY OF Y
A.	Positive	Negative
B.	Positive	Positive
C.	Negative	Negative
D.	Negative	Positive

20. Three positive charges are fixed as shown in the diagram below.

Calculate the net electric force on $\boldsymbol{Q_2}$ due to Q_1 and Q_3.

	MAGNITUDE OF FORCE	DIRECTION OF FORCE
A.	3.1 N	Left
B.	3.1 N	Right
C.	5.9 N	Left
D.	5.9 N	Right

OVER

21. A cathode ray tube beam deflects to the location as shown in Diagram I when a certain voltage is applied to the deflecting plates.

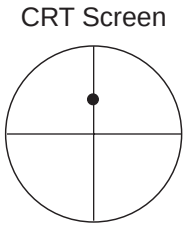


Diagram I

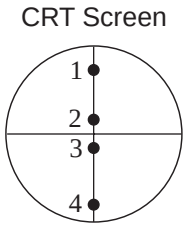
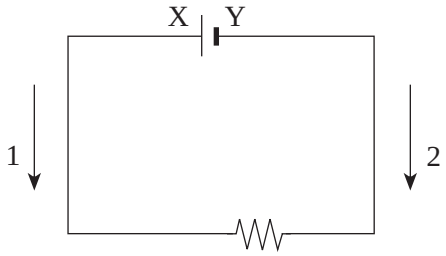


Diagram II

The connections to the deflecting plates are then **reversed** and the deflecting voltage is **reduced**. Which location in Diagram II best represents the new beam position?

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

22. Which of the following correctly labels arrows 1 and 2 and polarities X and Y in the circuit below?

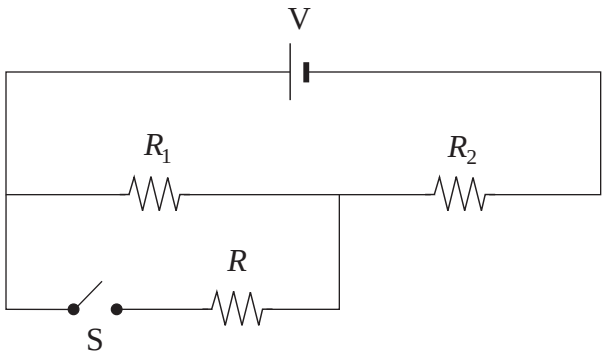


	ARROW 1	ARROW 2	POLARITY X	POLARITY Y
A.	Electron Flow	Conventional Current	Positive	Negative
B.	Electron Flow	Conventional Current	Negative	Positive
C.	Conventional Current	Electron Flow	Positive	Negative
D.	Conventional Current	Electron Flow	Negative	Positive

23. Which of the following household electrical appliances has the greatest rate of energy consumption?

	ITEM	VOLTAGE	CURRENT
A.	Video Camera	6.0 V	1.6 A
B.	Radio	4.5 V	0.45 A
C.	Cassette Recorder	6.0 V	2.2 A
D.	Ghetto Blaster	12 V	1.4 A

24. Switch S is originally open as shown in the circuit below.



How does the current through resistors R_1 and R_2 change when switch S is closed?

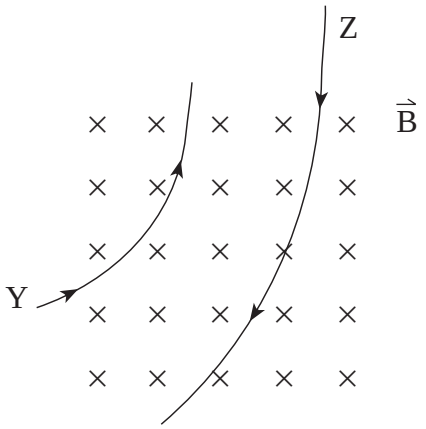
	CURRENT THROUGH R_1	CURRENT THROUGH R_2
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	decreases	decreases

25. In a **step-up** transformer, how does the secondary voltage V_s compare with the primary voltage V_p, and the number of turns in the secondary N_s compare with the number of turns in the primary N_p ?

	VOLTAGE	NUMBER OF TURNS
A.	$V_s < V_p$	$N_s > N_p$
B.	$V_s > V_p$	$N_s > N_p$
C.	$V_s < V_p$	$N_s < N_p$
D.	$V_s > V_p$	$N_s < N_p$

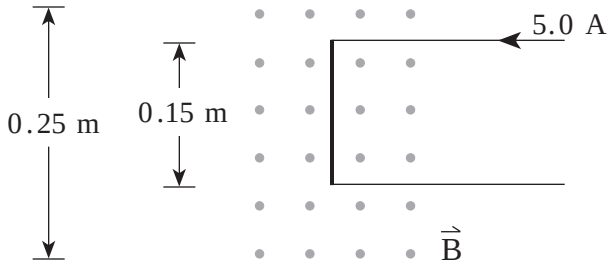
OVER

26. Two particles Y and Z with equal mass and speed enter a uniform magnetic field and follow the paths as shown. How do their magnitude and polarity of charge compare?



	MAGNITUDE OF CHARGE	POLARITY
A.	Y < Z	same charge
B.	Y < Z	opposite charge
C.	Y > Z	same charge
D.	Y > Z	opposite charge

27. A wire carrying a current of 5.0 A is in a uniform 3.2×10^{-2} T magnetic field as shown. What is the force on the 0.15 m length of wire?



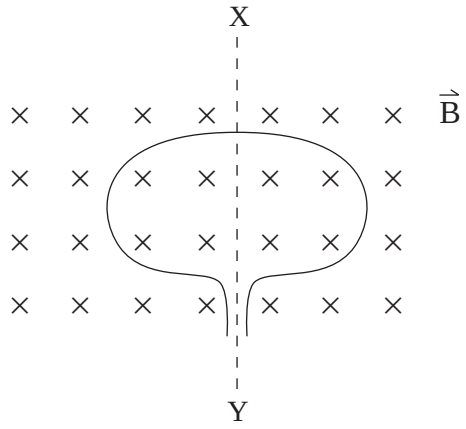
A. 0 N

B. 1.6×10^{-2} N

C. 2.4×10^{-2} N

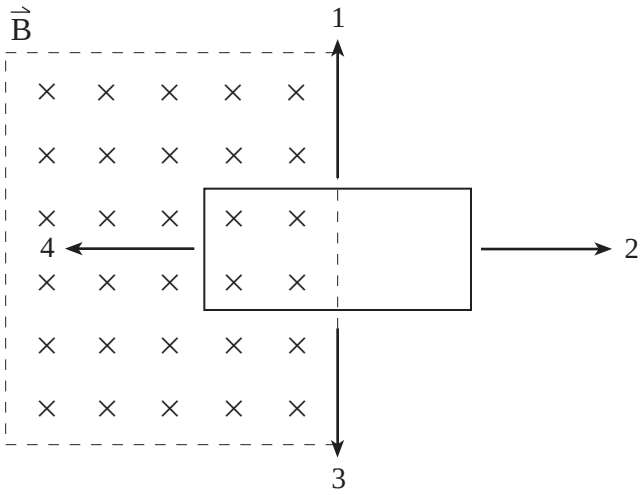
D. 4.0×10^{-2} N

28. A single coil of wire of area $6.0\times10^{-3}\ \text{m}^2$ is positioned in a uniform $0.18\ \text{T}$ magnetic field as shown. The coil is rotated $90°$ about axis XY in $4.2\times10^{-3}\ \text{s}$. What average emf is induced by the coil?



A. 0 V
B. 0.13 V
C. 0.26 V
D. 43 V

29. A part of a coil of wire is placed in a uniform magnetic field as shown. Which two directions of motion would immediately induce an emf in the coil?



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

OVER

30. An electric motor is connected to a constant source of potential. Considering back emf, which of the following observations is correct?

A. At full speed the applied voltage increases.
B. At full speed the armature resistance increases.
C. If the motor is kept from rotating at full speed, the armature heats up.
D. If the motor is kept from rotating at full speed, the armature temperature decreases.

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.

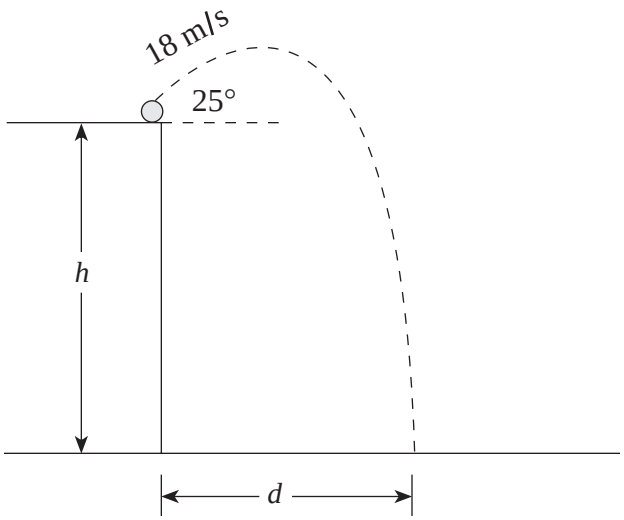
3. You are expected to communicate your knowledge and understanding of physics principles in a clear and logical manner. Partial marks will be awarded for steps and assumptions leading to a solution. Full marks will **not** be awarded for providing a final answer **only**.

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.

   Full marks will NOT be given for the final answer only.

OVER

1. A rock is thrown from a clifftop at $18\ \text{m/s}$, $25°$ above the horizontal. It lands on the beach $4.2\ \text{s}$ later.



a) What is the height h of the cliff? **(4 marks)**

b) How far from the base of the cliff d did the rock land? **(3 marks)**

ANSWER:

a) height: _____

b) horizontal distance: _____

OVER

2. A 0.030 kg toy car is pushed back against a spring-based launcher as shown in Diagram 1.

Diagram 1

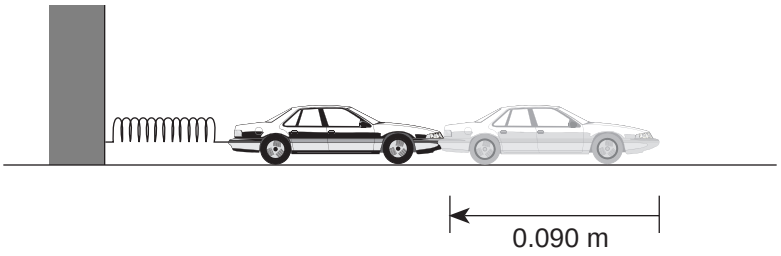
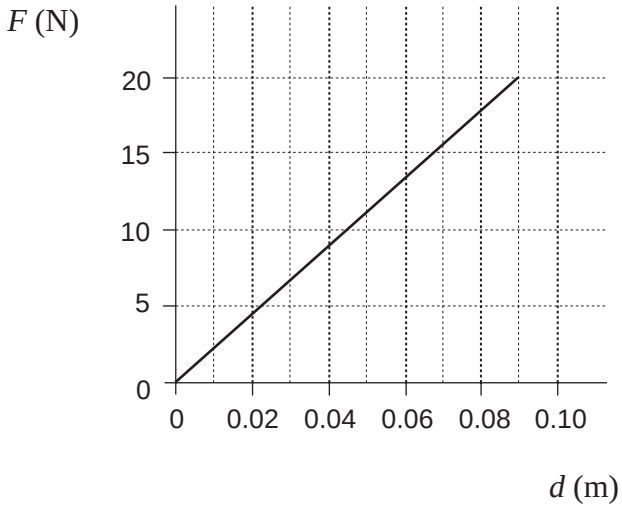


Diagram 2 shows a graph of the force required to compress the spring 0.090 m.

Diagram 2



a) What is the work done in compressing the spring? **(3 marks)**

b) Assuming no losses due to heat, what maximum speed is reached by the toy car when it is released? **(3 marks)**

c) If in fact the maximum kinetic energy of the car is $0.18\ \text{J}$, what is the efficiency of the spring-based launcher? **(1 mark)**

ANSWER:

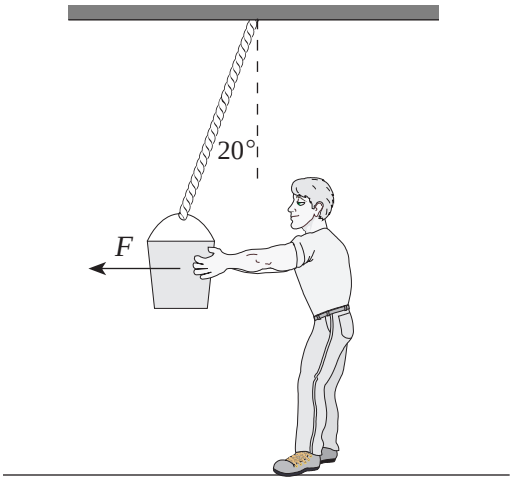
a) work: _____

b) maximum speed: _____

c) efficiency: _____

OVER

3. Peter exerts a horizontal force F on a 12 kg bucket of concrete so that the supporting rope makes an angle of $20°$ with the vertical.



a) Find the tension force in the supporting rope. **(5 marks)**

b) Peter now exerts a new force which causes the rope to make a greater angle with the vertical. How will the tension force in the supporting rope change?

- ❒ The tension force will increase.
- ❒ The tension force will decrease.
- ❒ The tension force will remain the same.

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

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

ANSWER:

a) tension force: _____

OVER

4. A 650 kg satellite in circular orbit around Earth has an orbital period of 1.5×10^4 s.

   a) What is the satellite's orbital radius? **(5 marks)**

b) What is the gravitational potential energy of this satellite? **(2 marks)**

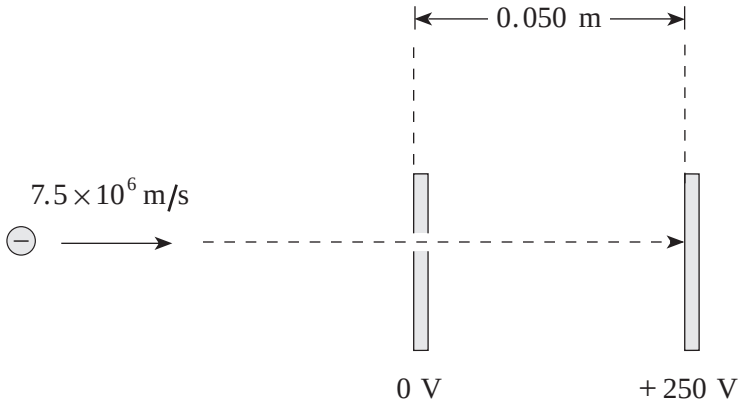
ANSWER:

a) radius: _____

b) potential energy: _____

OVER

5. An electron moving at 7.5×10^6 m/s enters an electric field between parallel plates by passing through a small hole in one of the plates.



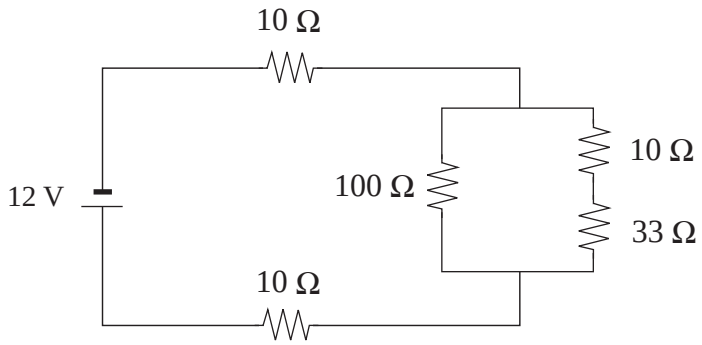
What is the impact speed of the electron on the second plate? **(7 marks)**

ANSWER:

speed: _____

OVER

6. What is the power dissipated in the $33\ \Omega$ resistor in the circuit shown below? **(7 marks)**



ANSWER:

power dissipated: _____

OVER

7. A motor is connected to a constant $120\ \text{V}$ source and draws a current of $38.0\ \text{A}$ when it first starts up. At its normal operating speed, the motor draws a current of $2.50\ \text{A}$.

   a) What is the resistance of the armature coil? **(3 marks)**

b) What is the back emf at normal speed? **(4 marks)**

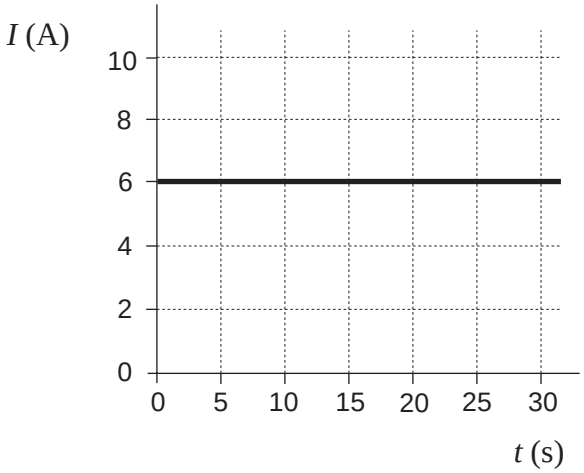
ANSWER:

a) resistance: _____

b) back emf: _____

OVER

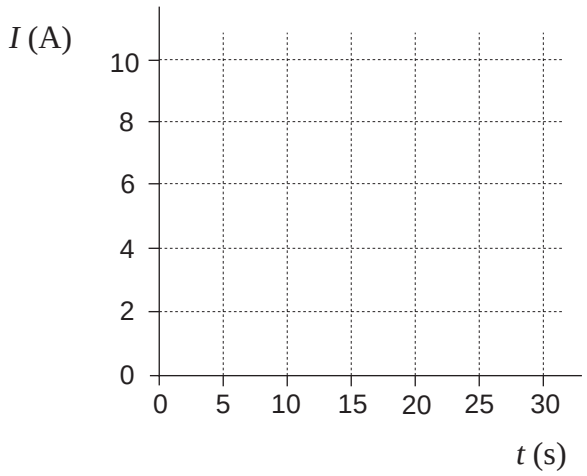
8. A power supply was connected to a resistor and a student plotted the graph of current, I, flowing through the resistor versus time, t, as shown below.



a) Calculate the area under the graph between $t = 0$ s and $t = 30$ s. **(2 marks)**

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

c) The same power supply is connected to a resistor of greater resistance. For this new set-up, sketch a possible graph on the axes below and label it c). **(2 marks)**

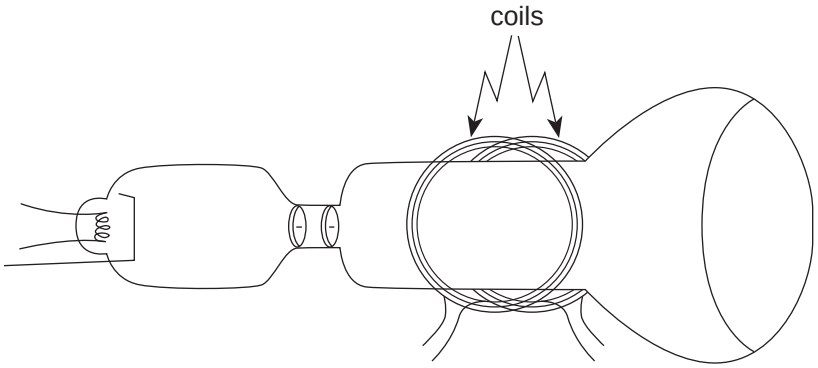


ANSWER:

a) area: _____

OVER

9. a) In a cathode ray tube, the purpose of the coils is to



- ❒ focus the beam of electrons.
- ❒ deflect the beam of electrons.
- ❒ decrease the speed of the electrons.

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

b) Using the principles of electromagnetism, explain how this effect on the electrons is achieved by the coils. **(3 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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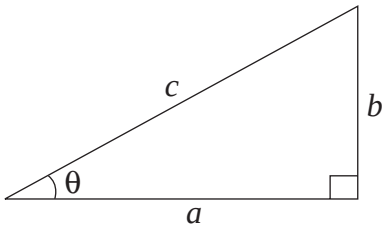
For Right-angled Triangles:

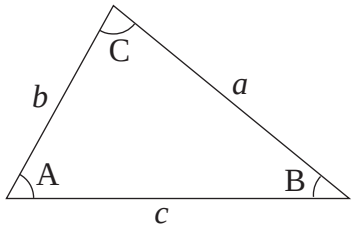


$$a^2 + b^2 = c^2$$

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

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

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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Electrostatics:

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

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

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

Electric Circuits:

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

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

Electromagnetism:

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

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

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

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

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

ROUGH WORK FOR MULTIPLE-CHOICE

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INSERT STUDENT I.D. NUMBER (PEN)

STICKER IN THIS SPACE

PHYSICS 12

August 1998

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August 1998

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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)