Insert Personal Education Number (PEN) here.

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PHYSICS 12

AUGUST 2000

COURSE CODE = PH

STUDENT INSTRUCTIONS

1. Insert 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.

Insert **only** hand-printed PEN here.

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BRITISH COLUMBIA

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Question 1:

1. [ ] . [ ]

(7)

Question 9:

9. [ ] . [ ]

(4)

Question 2:

2. [ ] . [ ]

(9)

Question 3:

3. [ ] . [ ]

(7)

Question 4:

4. [ ] . [ ]

(7)

Question 5:

5. [ ] . [ ]

(7)

Question 6:

6. [ ] . [ ]

(7)

Question 7:

7. [ ] . [ ]

(7)

Question 8:

8. [ ] . [ ]

(5)

PHYSICS 12

AUGUST 2000

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 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.

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

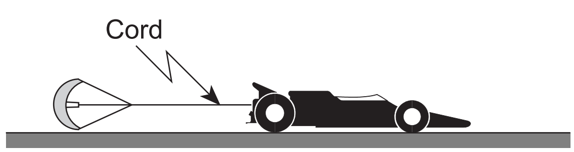
Value: 60 marks (2 marks per question) **Suggested Time: 60 minutes**

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. A book is at rest on a desk. Which of the following statements concerning the book is correct?

   A. The desk exerts no force on the book.
   B. The book exerts no force on the desk.
   C. There are no forces acting on the book.
   D. The forces acting on the book are balanced.

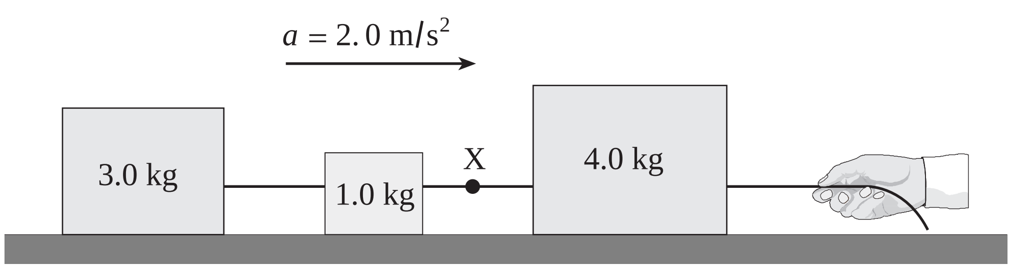
2. An 810 kg dragster is being decelerated by a parachute at $2.5\ \text{m/s}^2$ as shown in the diagram.



   What is the tension in the cord at this moment?

   A. $0\ \text{N}$
   B. $2.0\times10^3\ \text{N}$
   C. $5.9\times10^3\ \text{N}$
   D. $7.9\times10^3\ \text{N}$

3. The system of blocks on a frictionless surface in the diagram below is accelerating at $2.0\ \text{m/s}^2$.

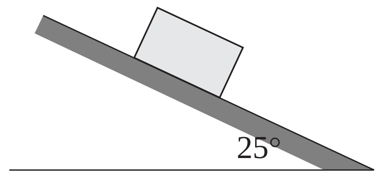


   What is the tension in the cord at X?

   A. $2.0\ \text{N}$
   B. $6.0\ \text{N}$
   C. $8.0\ \text{N}$
   D. $16\ \text{N}$

OVER

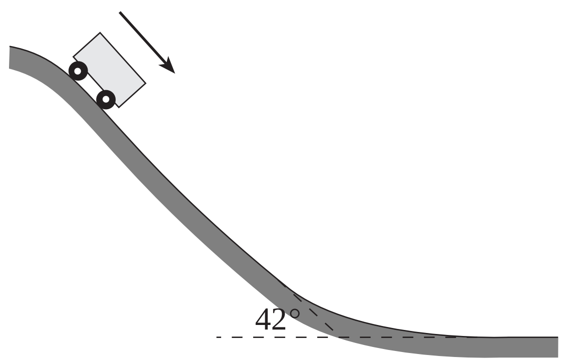
4. A 5.0 kg block remains stationary on an inclined surface.



What is the friction force acting on the block?

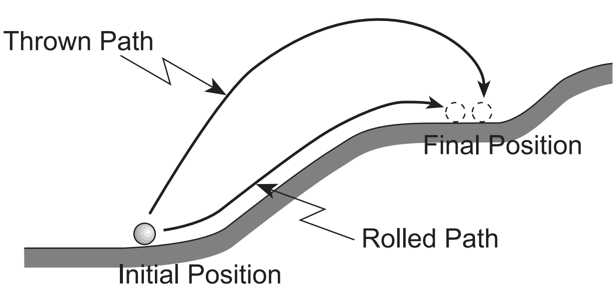
A. 21 N
B. 23 N
C. 44 N
D. 49 N

5. What is the acceleration of the roller coaster car in the diagram below? Ignore friction.



A. 6.6 m/s^2
B. 7.3 m/s^2
C. 8.8 m/s^2
D. Depends on car's mass.

6. A child rolls a ball up a hill as shown. The same child then throws an identical ball up the hill.



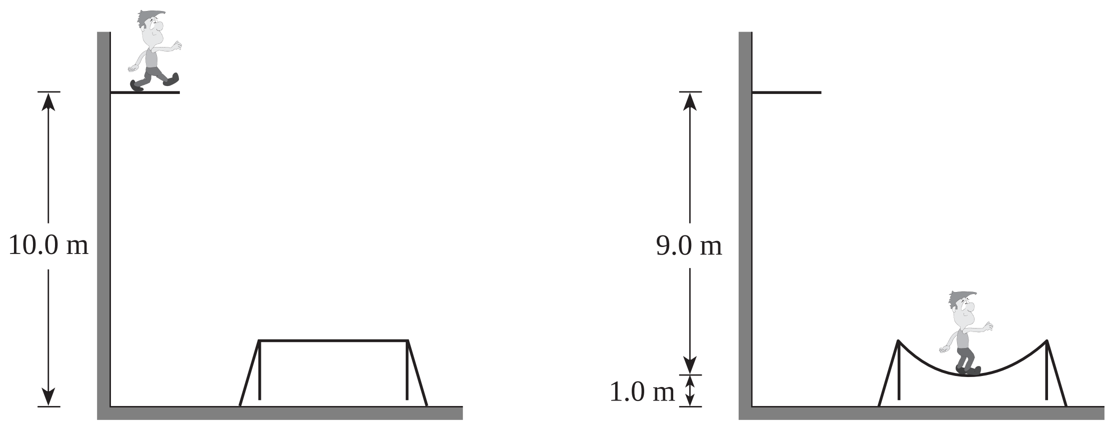
When both balls end up in the same location on the hill, which of the following correctly describes the potential energy change for each ball?

A. Both balls have the same potential energy change.
B. There is no potential energy change for either ball.
C. The thrown ball has a greater potential energy change than the rolled ball.
D. The thrown ball has a smaller potential energy change than the rolled ball.

7. A 950 kg elevator ascends a vertical height of 410 m with an average speed of 9.1 m/s. What average power must the lifting motor supply?

A. 8.6×10^{3} W
B. 8.5×10^{4} W
C. 4.2×10^{5} W
D. 3.8×10^{6} W

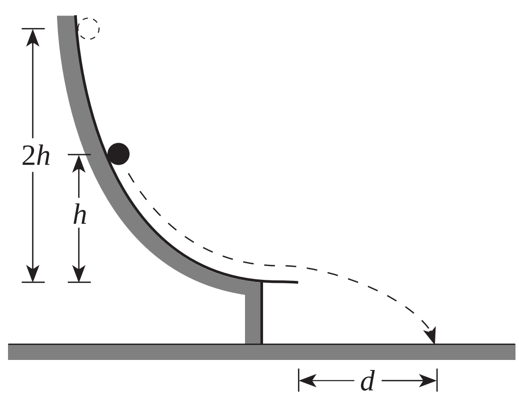
8. A 55.0 kg athlete steps off a 10.0 m high platform and drops onto a trampoline. As the trampoline stretches, it brings him to a stop 1.00 m above the ground.



How much energy must have been momentarily stored in the trampoline when he came to rest?

A. 0 J
B. 539 J
C. 4 850 J
D. 5 390 J

9. An object starts from rest and slides down a frictionless track as shown. It leaves the track horizontally, striking the ground at a distance *d* as shown.



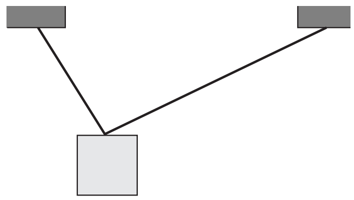
The same object is now released from twice the height, $2h$. How far away will it land?

A. d
B. $\sqrt{2}\,d$
C. $2d$
D. $4d$

OVER

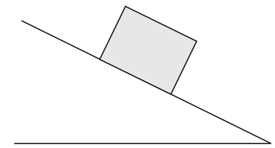
10. Which of the four problems shown requires the application of torque?

A.



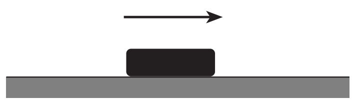
What is the tension in the supporting cables?

B.



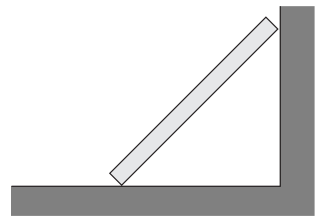
What is the friction force acting on the block?

C.



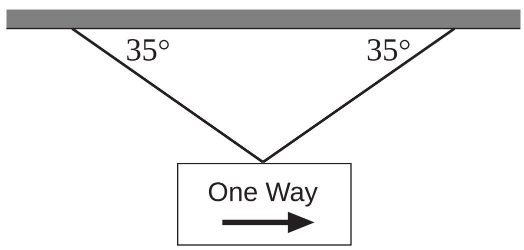
What is the acceleration of the puck?

D.



What force does the wall exert on the board?

11. A traffic sign hangs from two cables as shown.



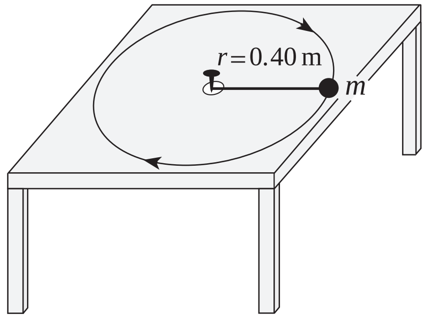
If the tension in each cable is 220 N, what is the weight of the sign?

A. 130 N
B. 250 N
C. 360 N
D. 440 N

12. A car travels at a uniform speed through a level circular curve in the road. Which of the following correctly describes the magnitude of the acceleration, velocity and force acting on the car?

	MAGNITUDE OF ACCELERATION	MAGNITUDE OF VELOCITY	MAGNITUDE OF FORCE
A.	constant	constant	constant
B.	constant	changing	changing
C.	constant	changing	constant
D.	changing	changing	changing

13. An object is attached to a string that can withstand a maximum tension force of $6.3\ \text{N}$. The object travels in a circular path of radius $0.40\ \text{m}$ with a period of $2.1\ \text{s}$.



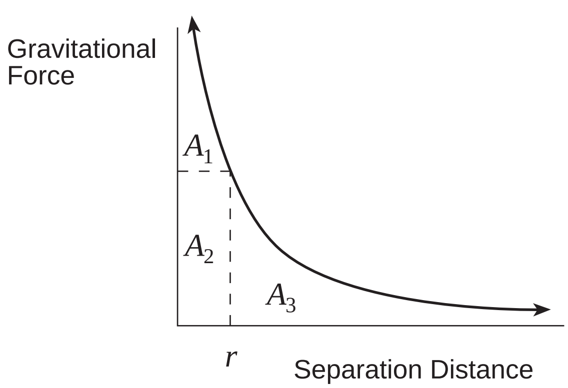
What is the maximum mass of the object?

A. $0.57\ \text{kg}$
B. $0.64\ \text{kg}$
C. $1.8\ \text{kg}$
D. $3.6\ \text{kg}$

14. A 65 kg pilot in a stunt plane performs a vertical loop with a 700 m radius. The plane reaches a speed of $210\ \text{m/s}$ at the bottom of the loop. What is the upward force on the pilot at the bottom of the loop?

A. 640 N
B. 3 500 N
C. 4 100 N
D. 4 700 N

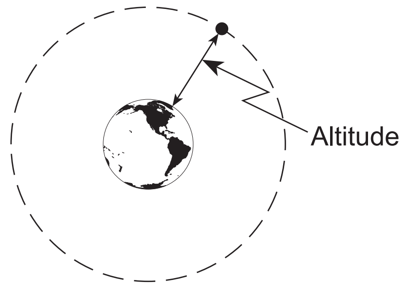
15. Which of the indicated areas of the graph represent the work needed to send an object from separation distance r to infinity?



A. $A_1 + A_2$
B. A_2
C. $A_2 + A_3$
D. A_3

OVER

16. A satellite experiences a gravitational force of 228 N at an altitude of 4.0×10^{7} m above Earth.



What is the mass of this satellite?

A. 23 kg
B. 650 kg
C. 910 kg
D. 1 200 kg

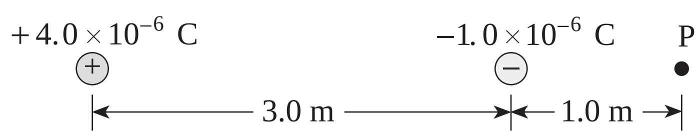
17. A 1 570 kg satellite orbits a planet in a circle of radius 5.94×10^{6} m. Relative to zero at infinity the gravitational potential energy of this satellite is -9.32×10^{11} J. What is the mass of the planet?

A. 5.29×10^{25} kg
B. 8.31×10^{28} kg
C. 3.14×10^{31} kg
D. 4.93×10^{34} kg

18. The electric field is uniform between

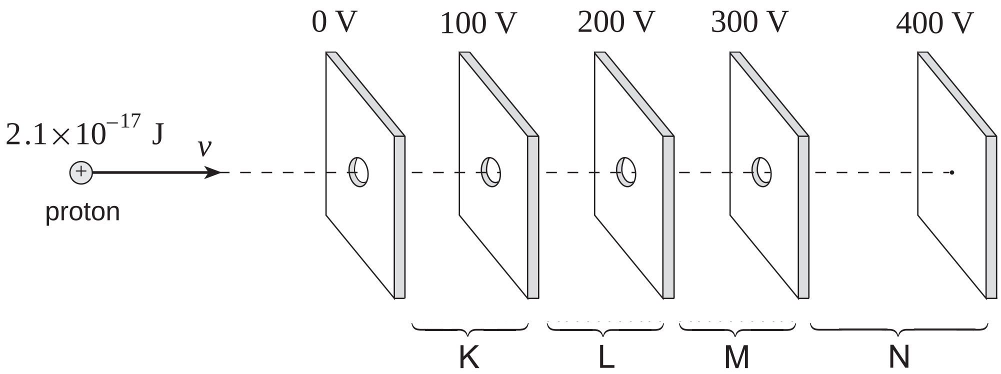
A. two positive point charges.
B. two negative point charges.
C. two opposite point charges.
D. two oppositely charged parallel plates.

19. What is the magnitude and direction of the electric field at point P due to the two fixed charges?



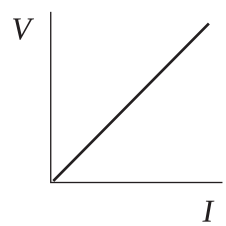
	ELECTRIC FIELD AT POINT P	
	MAGNITUDE	DIRECTION
A.	6 800 N/C	Right
B.	6 800 N/C	Left
C.	11 000 N/C	Right
D.	11 000 N/C	Left

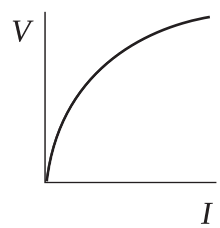
20. A proton with kinetic energy of 2.1×10^{-17} J is moving into a region of charged parallel plates. The proton will be stopped momentarily in what region?

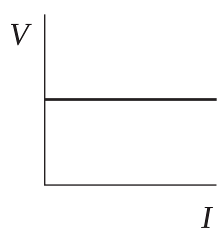


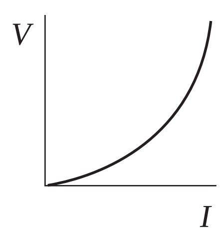
A. Region K
B. Region L
C. Region M
D. Region N

21. Which of the following graphs illustrates Ohm's law?

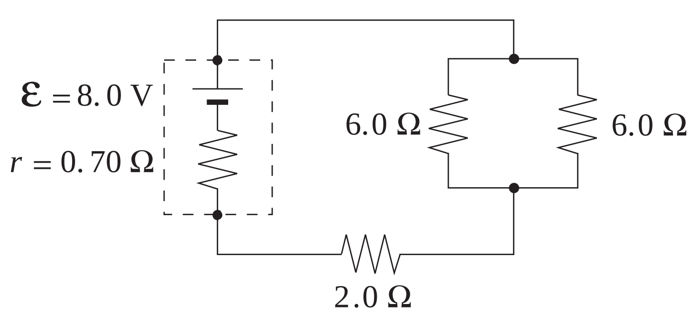
A.


B.


C.


D.


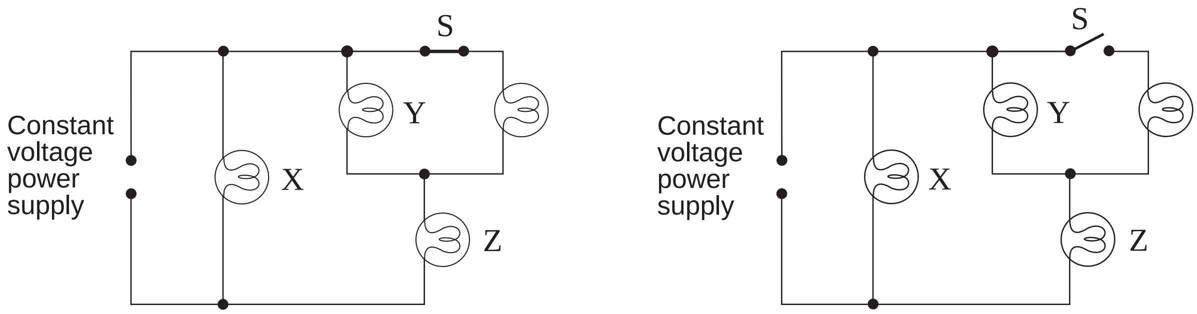
22. In the following circuit, what is the terminal voltage of the battery?



A. 6.9 V
B. 7.0 V
C. 8.0 V
D. 9.0 V

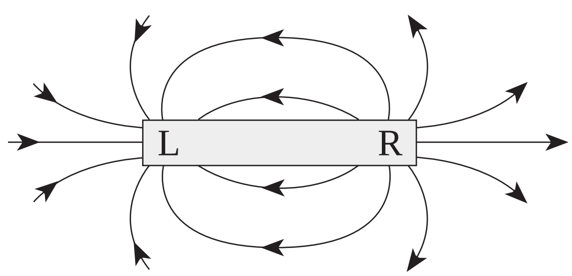
OVER

23. If switch S is opened, how does the brightness of each bulb (X, Y, and Z) compare to the situation when the switch was closed?



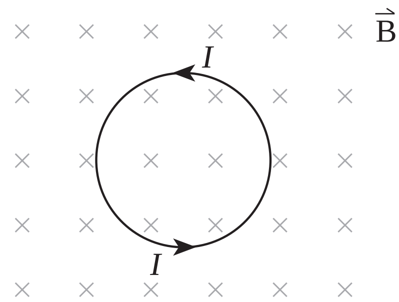
	BULB X	BULB Y	BULB Z
A.	same	same	same
B.	same	dimmer	brighter
C.	same	brighter	dimmer
D.	dimmer	dimmer	dimmer

24. Identify the magnetic poles labelled L and R in the diagram shown.



	POLE L	POLE R
A.	North	North
B.	North	South
C.	South	North
D.	South	South

25. The diagram shows current I flowing in a circular coil located in a magnetic field.



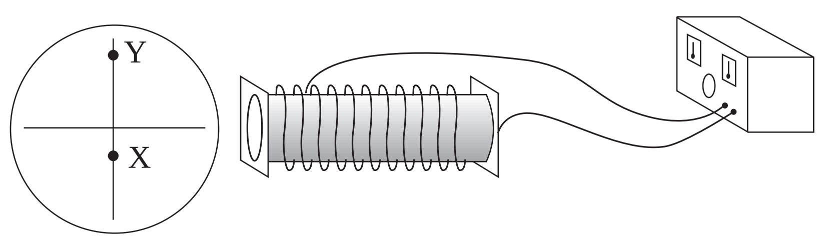
The magnetic force acting on the coil will tend to cause it to

A. expand.
B. contract.
C. move up the page.
D. move down the page.

26. An aircraft whose wingspan is 15 m carries a static charge of 0.60 C. It travels at 240 m/s perpendicular to a 1.5×10^{-4} T magnetic field. What magnetic force does the aircraft experience?

A. 0.022 N
B. 0.060 N
C. 0.54 N
D. 9.6×10^{5} N

27. An undeflected electron beam strikes the centre of a cathode ray tube. A solenoid placed beside a cathode ray tube causes the electron beam to strike the screen at position X.



What changes to the magnitude and direction of the current in the solenoid would cause the electron beam to strike the screen at Y?

	CHANGE TO CURRENT MAGNITUDE	CHANGE TO CURRENT DIRECTION
A.	Increases	Remains the same
B.	Increases	Reverses
C.	Decreases	Remains the same
D.	Decreases	Reverses

OVER

28. A coil having 150 turns and a cross-sectional area of $0.042\ \mathrm{m}^2$ is oriented with its plane perpendicular to a $0.12\ \mathrm{T}$ magnetic field. If the field increases to $0.66\ \mathrm{T}$ in $0.25\ \mathrm{s}$, what emf is induced in the coil?

A. 9.8 V
B. 14 V
C. 20 V
D. 320 V

29. An electric motor rotates at various speeds and the current through the armature changes accordingly. Which pair of conditions occurs when the motor generates the greatest back emf?

	SPEED	CURRENT THROUGH THE ARMATURE
A.	Fastest	Largest
B.	Fastest	Smallest
C.	Slowest	Largest
D.	Slowest	Smallest

30. A transformer connected to a 120 V ac supply has 7 000 primary and 350 secondary windings. It delivers a secondary current of $2.4\ \mathrm{A}$. Find the primary current and secondary voltage.

	PRIMARY CURRENT	SECONDARY VOLTAGE
A.	0.12 A	6.0 V
B.	0.12 A	2 400 V
C.	48 A	6.0 V
D.	48 A	2 400 V

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. An aircraft heads due south with a speed relative to the air of 44 m/s. Its resultant speed over the ground is 47 m/s. The wind blows from the west.

   a) What is the speed of the wind? **(4 marks)**

ANSWER:

a) speed of the wind: ____________________

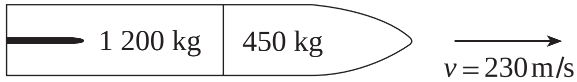
b) What is the direction of the aircraft's path over the ground? **(3 marks)**

ANSWER:

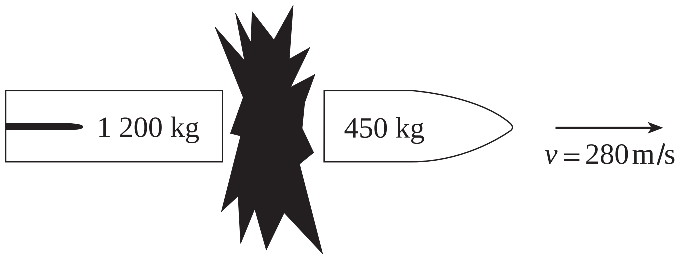
b) direction: ______________________________

OVER

2. A space vehicle made up of two parts is travelling at 230 m/s as shown.



An explosion causes the 450 kg part to separate and travel with a final velocity of 280 m/s as shown.



a) What was the momentum of the space vehicle before the explosion? **(2 marks)**

ANSWER:

a) momentum: ______________________

b) What was the magnitude of the impulse on the 1 200 kg part during the separation?

(3 marks)

c) Using principles of physics, explain what changes occur, if any, to the

i) momentum of the system as a result of the explosion. **(2 marks)**

____

____

____

ii) kinetic energy of the system as a result of the explosion. **(2 marks)**

____

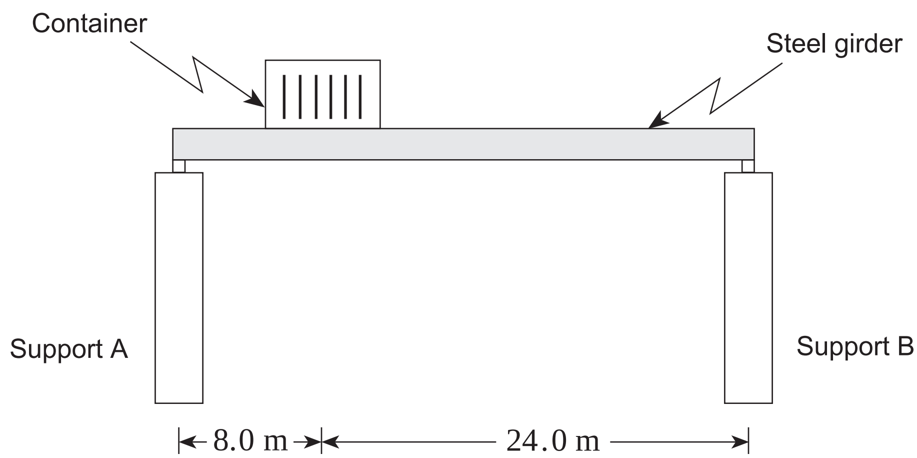
____

____

ANSWER:
b) magnitude: ____________________

OVER

3. A uniform 1 200 kg steel girder is supported horizontally at its endpoints as shown in the diagram.



What are the upward forces at the girder end points when it is bearing a 3 700 kg shipping container 8.0 m from support A? **(7 marks)**

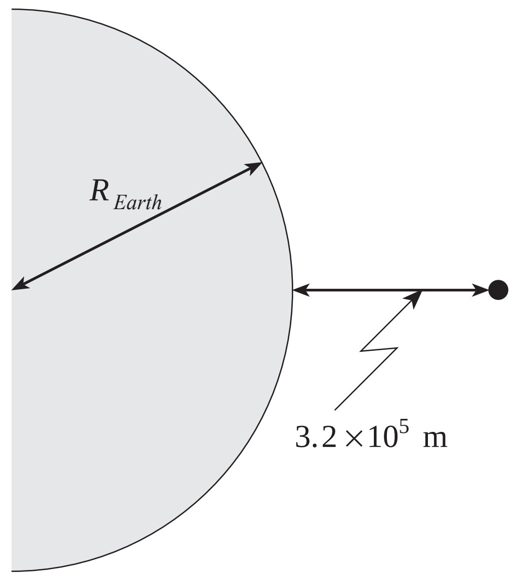
ANSWER:

upward force at A: ______________________

upward force at B: ______________________

OVER

4. A 4.00×10^{3} kg object is lifted from the earth's surface to an altitude of 3.2×10^{5} m. How much work does this require? **(7 marks)**



(Diagram not to scale.)

ANSWER:

work: ____________________________________

OVER

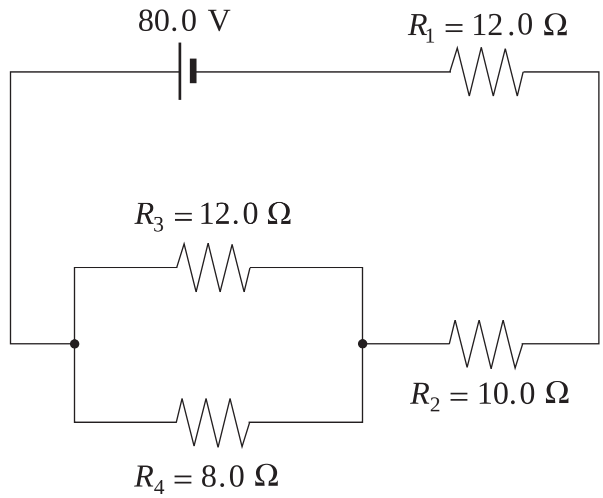
5. A proton, initially at rest at point X, will have what speed at point Y? **(7 marks)**

ANSWER:

speed of proton: ______________________

OVER

6. What is the power dissipated in the $8.0\ \Omega$ resistor in the circuit as shown? **(7 marks)**



ANSWER:

power dissipated: ______________________

OVER

7. The magnetic field at the centre of a solenoid of length 0.25 m is $1.2\times10^{-2}\text{ T}$. The current in the windings is 7.5 A.

   a) How many windings does the solenoid have? **(4 marks)**

ANSWER:

a) number of windings: ___________________

b) If the cross-sectional area of the solenoid is $8.5 \times 10^{-4}\ \text{m}^2$, what is the flux through it?

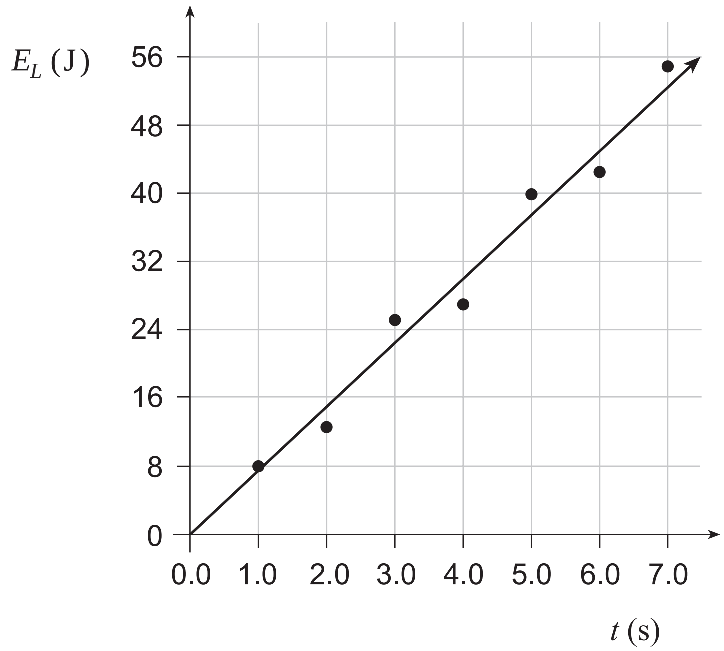
(3 marks)

ANSWER:

b) flux: ______________________________

OVER

8. The graph shows the light energy E_L emitted by a bulb versus time t.



a) Find the power output of the bulb. **(2 marks)**

ANSWER:

a) power output: ______________________

b) If this bulb is 20% efficient, find the power delivered to the bulb. **(3 marks)**

ANSWER:

b) power delivered: ______________________

OVER

9. In your summer job with the Ministry of Transportation and Highways your supervisor has told you that street signs should no longer be suspended as shown in Diagram A. In order to save money, he would prefer a shorter, perfectly horizontal cable, as shown in Diagram B.

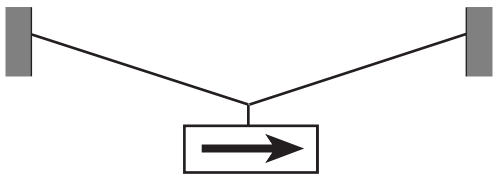


Diagram A

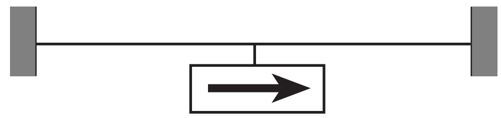


Diagram B

Using principles of physics, argue that the situation in Diagram B is not reasonable. **(4 marks)**

END OF EXAMINATION

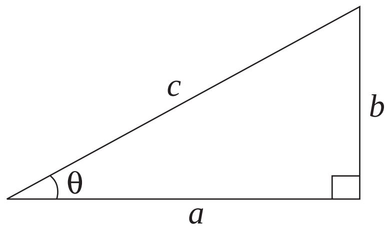
TABLE OF CONSTANTS

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.

MATHEMATICAL EQUATIONS

For Right-angled Triangles:

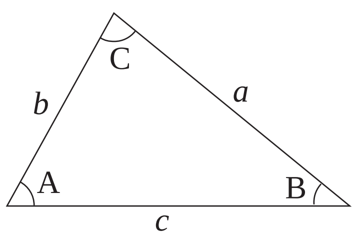


$$a^2 + b^2 = c^2$$

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

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

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

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:

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

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

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:

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

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

Electromagnetism:

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

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

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

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

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

You may detach this page for convenient reference.
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ROUGH WORK FOR MULTIPLE-CHOICE