INSERT STUDENT I.D. NUMBER (PEN)

STICKER IN THIS SPACE

JUNE 1996

PROVINCIAL EXAMINATION

MINISTRY OF EDUCATION, SKILLS AND TRAINING

PHYSICS 12

GENERAL INSTRUCTIONS

1. Insert the stickers with your Student I.D. Number (PEN) in the allotted spaces above. **Under no circumstance is your name or identification, other than your Student I.D. Number, to appear on this paper.**

2. Take the separate Answer Sheet and follow the directions on its front page.

3. Be sure you have an HB pencil and an eraser for completing your Answer Sheet. Follow the directions on the Answer Sheet when answering multiple-choice questions.

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

5. 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.

6. At the end of the examination, place your Answer Sheet inside the front cover of this booklet and return the booklet and your Answer Sheet to the supervisor.

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FOR OFFICE USE ONLY

INSERT STUDENT I.D. NUMBER (PEN)

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_____ – _____

PHYSICS 12 JUNE 1996 PROVINCIAL

Course Code = PH Examination Type = P

1. _____ (7)

2. _____ (7)

3. _____ (7)

4. _____ (9)

5. _____ (7)

6. _____ (7)

7. _____ (4)

Score **only one** of the following sections.

Section I		Section II		Section III
8. _____ (3)		11. _____ (3)		14. _____ (3)
9. _____ (4)	**or**	12. _____ (4)	**or**	15. _____ (4)
10. _____ (5)		13. _____ (5)		16. _____ (5)

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PHYSICS 12 PROVINCIAL EXAMINATION

		Value	Suggested Time
1.	This examination consists of **three** parts:		
PART A:	30 multiple-choice questions worth two marks each	60	60
PART B:	7 written-response questions	48	48
PART C:	Elected topics consisting of only written-response questions. Answer **only one** section.	12	12
	Total:	**120 marks**	**120 minutes**

2. The last **three** pages inside the back cover contain the **Data Table**, **Trigonometric and Other Equations**, **Equations,** and **Rough Work for Multiple-Choice**. These pages may be detached for convenient reference prior to writing this examination.

3. 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. An approved scientific calculator is essential for the examination. The calculator must be a hand-held device designed **only** for mathematical computations such as logarithmic and trigonometric functions. It **can be** programmable, but **must not** contain any graphing capabilities. You **must not** bring into the examination room any devices to support calculators such as manuals, printed or electronic cards, printers, memory expansion chips or cards, or keyboards.

5. You are permitted to use rulers, compasses and protractors.

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. You have **two hours** to complete this examination.

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PART A: MULTIPLE CHOICE

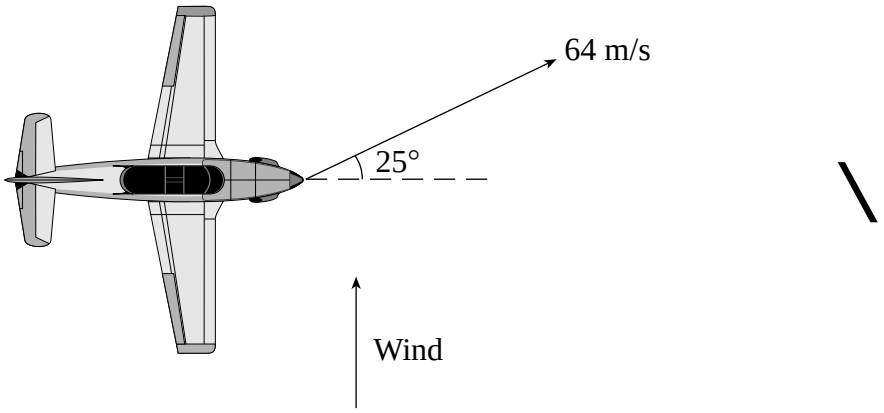
Value: 60 marks (2 marks per question) **Suggested Time: 60 minutes**

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

1. Which of the following remain(s) constant for a projectile: its horizontal velocity component, v_H, its vertical velocity component, v_V, its vertical acceleration, g?

   A. v_V
   B. g and v_V
   C. g and v_H
   D. g, v_H and v_V

2. A pilot points an aircraft due east, while the wind blows from the south.



   The resultant velocity of the aircraft over the ground is 64 m/s, 25° N of E . At what speed does the wind blow?

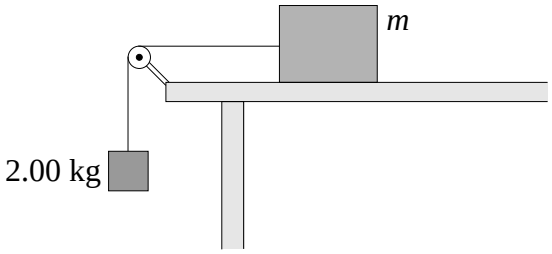
   A. 2.6 m/s
   B. 27 m/s
   C. 30 m/s
   D. 58 m/s

OVER

3. Gravitational field strength is measured in

   A. N
   B. N / C
   C. N / kg
   D. $N \cdot m^2 / kg^2$

4. The frictionless system shown below accelerates at $1.60\ m/s^2$ when released.



   Find the tension in the string while the system is accelerating.

   A. 3.20 N
   B. 16.4 N
   C. 19.6 N
   D. 22.8 N

5. Force F gives mass m_1 an acceleration of $4.0\ m/s^2$. The same force F gives mass m_2 an acceleration of $2.0\ m/s^2$. What acceleration would force F give to the two masses m_1 and m_2 if they were glued together?

   A. $1.0\ m/s^2$
   B. $1.3\ m/s^2$
   C. $3.0\ m/s^2$
   D. $6.0\ m/s^2$

6. Are momentum and impulse scalar or vector quantities?

	MOMENTUM	IMPULSE
A.	Scalar	Scalar
B.	Scalar	Vector
C.	Vector	Scalar
D.	Vector	Vector

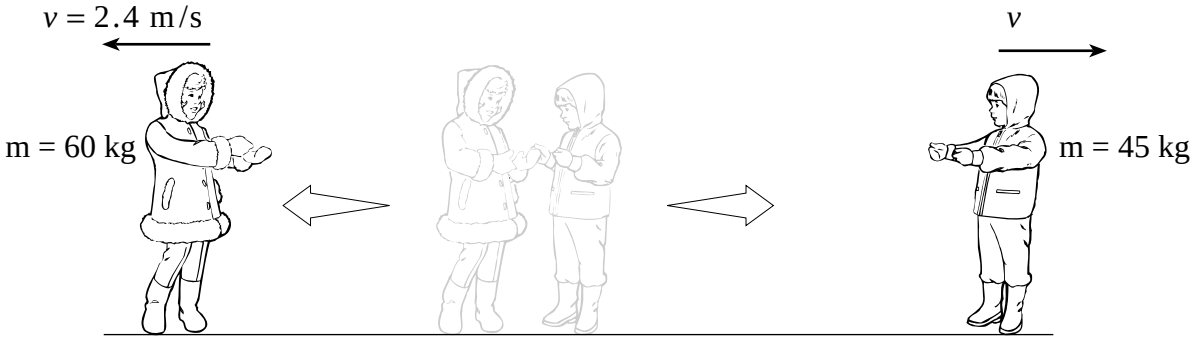
7. As a skier descends a slope, her kinetic energy increases from 600 J to 3 200 J while her gravitational potential energy decreases by 5 900 J. How much heat energy is created due to friction?

   A. 2 100 J
   B. 3 300 J
   C. 8 500 J
   D. 9 700 J

8. A rock is released from the top of a 30 m-high cliff at the same time as a ball is thrown upwards from the base of the cliff at 20 m/s. How much time elapses before they collide?

   A. 1.0 s
   B. 1.2 s
   C. 1.5 s
   D. 2.5 s

9. A 60 kg girl and her 45 kg brother are at rest at the centre of a frozen pond. He pushes her so that she slides away at 2.4 m/s. How much total work is done? (Ignore friction.)



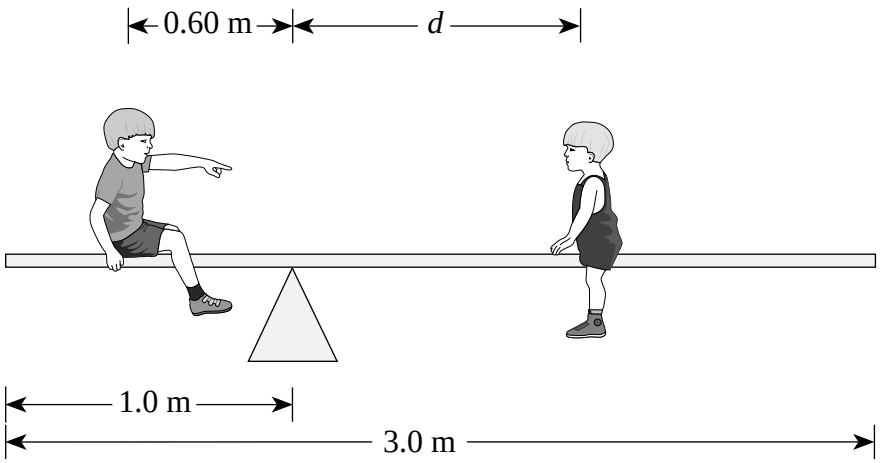
   A. 58 J
   B. 170 J
   C. 350 J
   D. 400 J

10. Two forces, 12 N west and 5.0 N north, act on an object. What is the direction of a third force that would produce static equilibrium?

   A. 23° south of east
   B. 23° north of west
   C. 67° south of east
   D. 67° north of west

OVER

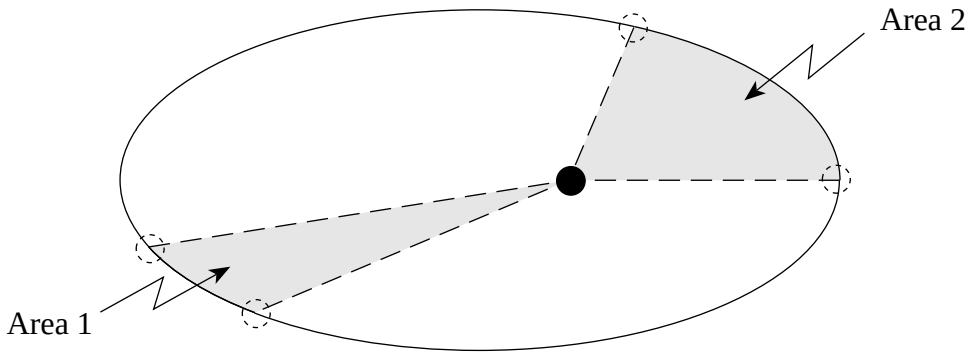
11. A 3.0 m uniform beam of mass 15 kg is pivoted 1.0 m from the end as shown below.



A 35 kg child sits 0.60 m from the pivot. How far, ***d***, from the pivot, must a 20 kg child sit in order for the beam to be in equilibrium?

A. 0.68 m
B. 1.0 m
C. 1.1 m
D. 1.4 m

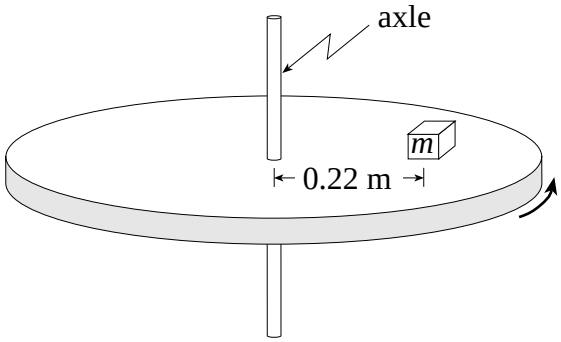
12. The diagram below shows the path of a planet orbiting a central mass.



The two areas are swept out in equal intervals of time. How does Area 1 compare to Area 2?

A. Area 1 is equal to Area 2.
B. Area 1 is less than Area 2.
C. Area 1 is greater than Area 2.
D. Insufficient information is given to compare the two areas.

13. An object of mass ***m*** is on a horizontal rotating platform. The mass is located 0.22 m from the axle and makes one revolution every 0.74 s.



The friction force needed to keep the mass from sliding is 13 N. What is the object's mass?

A. 0.82 kg
B. 1.3 kg
C. 2.7 kg
D. 5.2 kg

14. A 1 500 kg spaceship circles a planet once every 4.0×10^5 s with an orbital radius of 3.6×10^7 m. What is the mass of this planet?

A. 2.0×10^{11} kg
B. 1.2×10^{12} kg
C. 1.7×10^{23} kg
D. 2.6×10^{26} kg

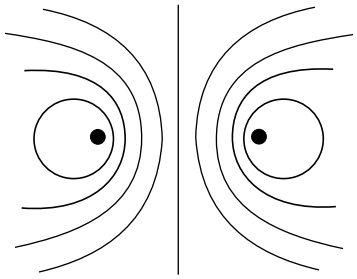
15. An object is located on the surface of a planet. The **work** required to remove this object from the planet's gravitational field depends on which combination of the following three variables: mass of the planet, mass of the object, and radius of the planet?

	MASS OF PLANET	MASS OF OBJECT	RADIUS OF PLANET
A.	Yes	Yes	Yes
B.	Yes	Yes	No
C.	Yes	No	Yes
D.	No	Yes	Yes

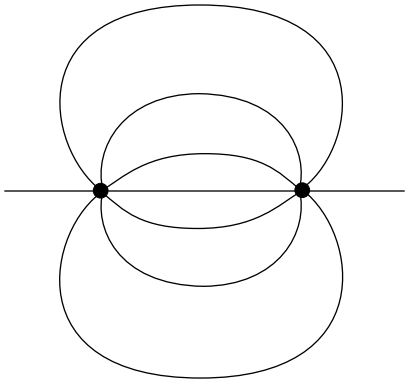
OVER

16. Which of the following diagrams **best** shows the electric field between two equal negative charges?

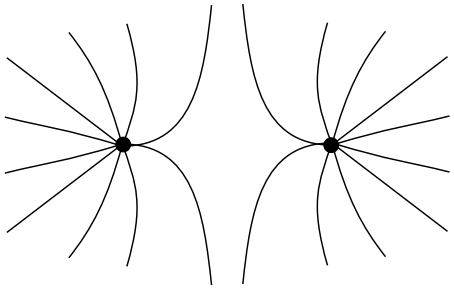
A.



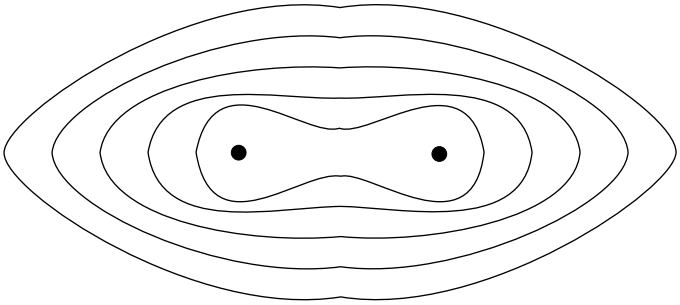
B.



C.



D.



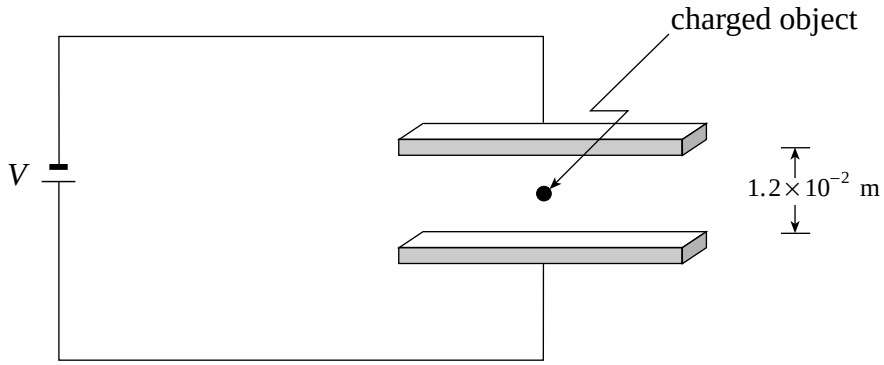
17. In a hydrogen atom, the electron and proton are separated by a distance of $5.3\times10^{-11}\,\text{m}$. What is the electric force exerted on the proton by the electron?

A. 0 N
B. 4.4×10^{-18} N
C. 8.2×10^{-8} N
D. 1.0×10^{12} N

18. A 2.5 C charge is moved from a point with a potential of 12 V to another point of potential 75 V. How much work was done on this charge?

A. 30 J
B. 160 J
C. 180 J
D. 220 J

19. An object with a charge of $+4.0\times10^{-18}$ C and a mass of 1.1×10^{-15} kg is held stationary by balanced gravitational and electric forces midway between horizontal charged plates as shown. What is the applied voltage ***V***?



A. 16 V

B. 32 V

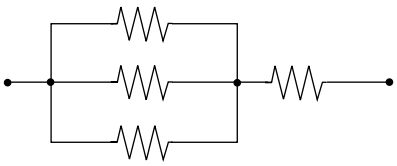
C. 65 V

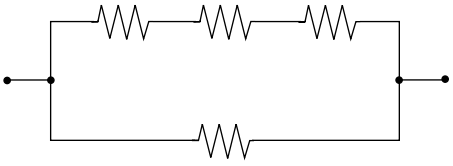
D. 2.7×10^{2} V

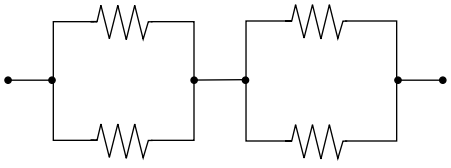
20. Which of the following instruments will measure the emf of a cell without drawing any current?

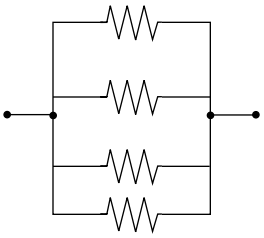
A. ammeter
B. voltmeter
C. ohmmeter
D. potentiometer

21. Which of the following arrangements would draw the largest current when connected to a potential difference? All resistors have the same value.

A.


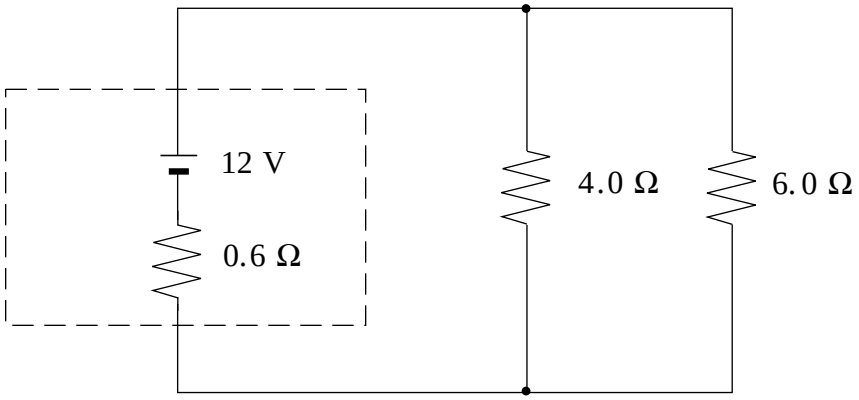
B.


C.


D.


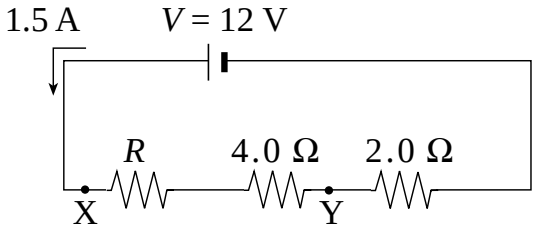
OVER

22. In the following circuit, what current flows through the $4.0\ \Omega$ resistor?



A. 2.4 A
B. 2.6 A
C. 3.0 A
D. 4.0 A

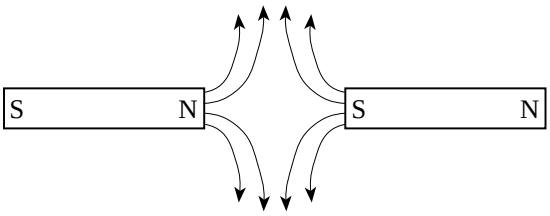
23. In the following circuit, what is the magnitude of the potential difference between **X** and **Y**?



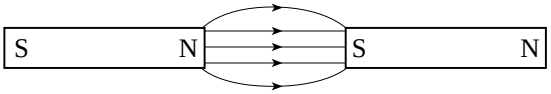
A. 3.0 V
B. 6.0 V
C. 9.0 V
D. 12 V

24. Which of the following diagrams **best** represents the magnetic field in the region between north and south poles of a pair of permanent magnets?

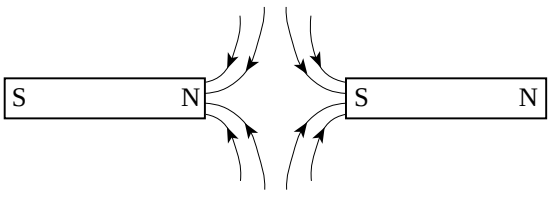
A.



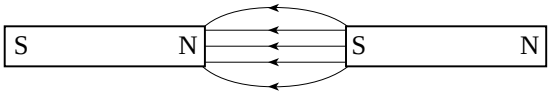
B.



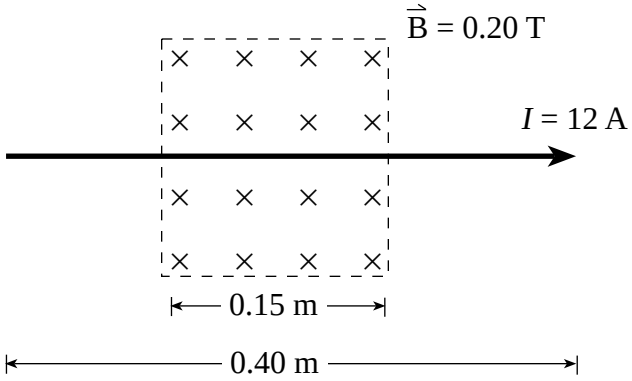
C.



D.



25. A long conductor is placed in a 0.20 T magnetic field as shown in the diagram below.



What are the magnitude and direction of the magnetic force on the conductor when it carries a current of 12 A?

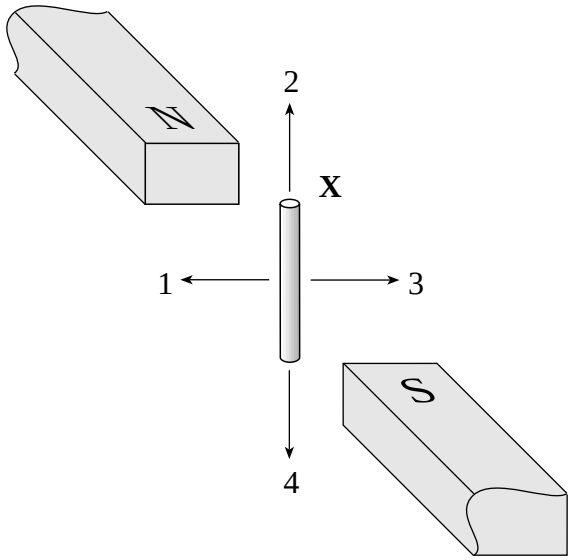
	MAGNITUDE OF THE MAGNETIC FORCE	DIRECTION OF THE MAGNETIC FORCE
A.	0.36 N	Up the page
B.	0.36 N	Down the page
C.	0.96 N	Up the page
D.	0.96 N	Down the page

26. A 150 turn coil has an area of $2.4\times10^{-4}\,\text{m}^2$. What magnetic field strength will produce a maximum torque of $2.2\times10^{-3}\,\text{N}\cdot\text{m}$ on the coil when a 0.20 A current flows through it?

A. $1.6\times10^{-5}\,\text{T}$
B. 0.13 T
C. 0.31 T
D. 3.3 T

OVER

27. A conductor is initially at rest in a magnetic field.



In which direction should the conductor be moved so that the end nearest **X** becomes positive?

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

28. A coil of 150 turns and an area of 2.0×10^{-4} m^2 is placed in a 1.00 T magnetic field as shown in Diagram I.

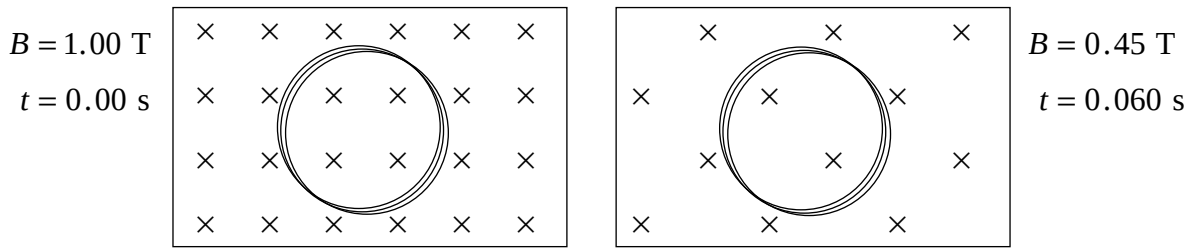


Diagram I Diagram II

If this field changes to 0.45 T in 0.060 s, what is the average emf induced in the coil and in what direction does the induced current flow?

	INDUCED EMF (V)	CURRENT DIRECTION
A.	0.28	Clockwise
B.	0.28	Counterclockwise
C.	0.36	Clockwise
D.	0.36	Counterclockwise

29. A dc motor has an armature resistance of $3.0\ \Omega$. When connected to a 24 V source the motor draws 1.4 A at maximum speed. What is the back emf produced by the motor at maximum speed?

A. 4.2 V
B. 20 V
C. 24 V
D. 28 V

30. A soldering iron transformer has 200 primary turns and 5 secondary turns. The primary draws 0.80 A at 120 V . Which of the following gives the secondary current and secondary voltage?

	SECONDARY CURRENT	SECONDARY VOLTAGE
A.	0.020 A	4 800 V
B.	0.80 A	120 V
C.	4.0 A	24 V
D.	32 A	3.0 V

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: 48 marks **Suggested Time: 48 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. 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. Partial marks will be awarded for steps and assumptions leading to a 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 soccer ball is kicked over level ground with an initial velocity of 18 m/s, 24° above the horizontal.

   a) How long does it take the ball to return to the ground? **(4 marks)**

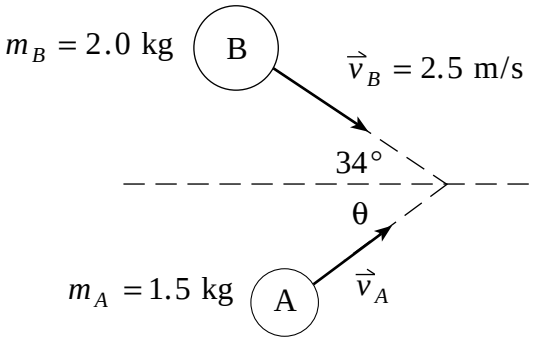
b) What is the range of the ball? **(3 marks)**

ANSWER:	Score for Question 1:
a) time:_____ b) range:_____	1. _____ (7)

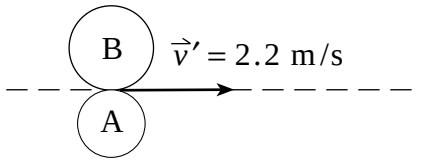
OVER

2. Two air pucks approach each other, stick together and then travel due east as shown below. Find the initial velocity (magnitude and direction) of puck **A**. **(7 marks)**

Before collision



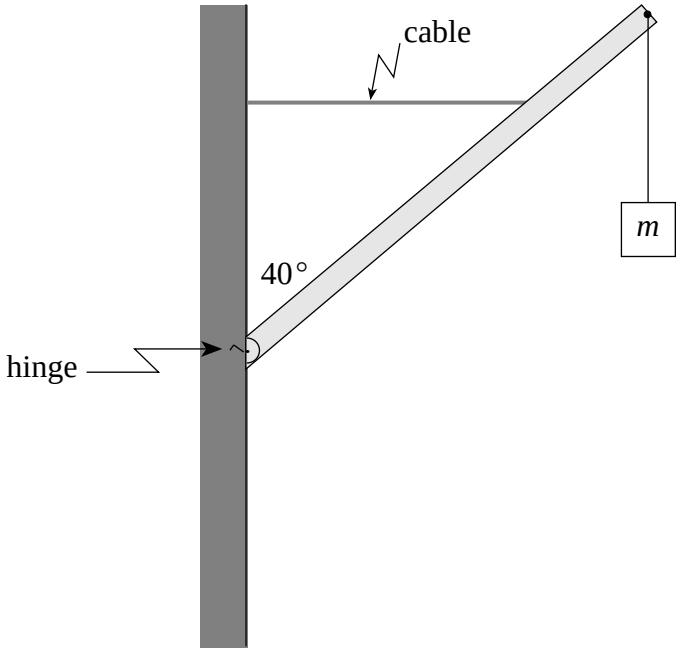
After collision



ANSWER: magnitude:_____ direction:_____	Score for Question 2: 2. _____ (7)

OVER

3. A uniform 350 kg beam of length 4.2 m is held stationary by a horizontal cable. The cable is attached to a point on the beam 3.0 m from the hinge.



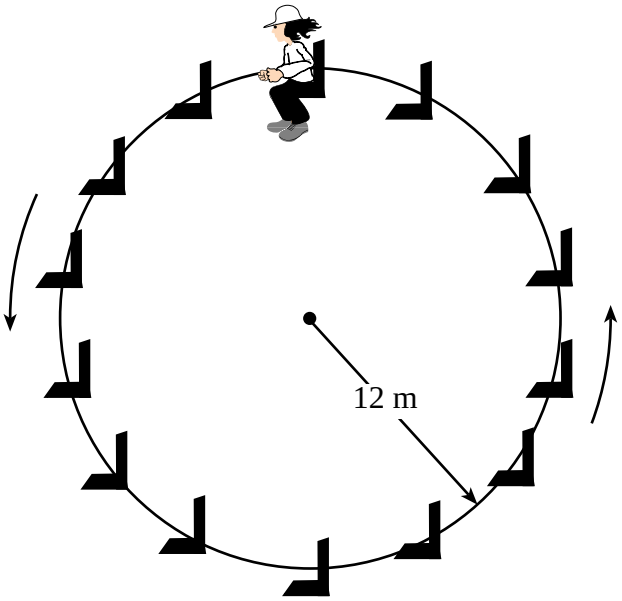
a) Draw and label a free body diagram showing the forces on the beam. **(2 marks)**

b) If the maximum tension the cable can withstand is 1.3×10^4 N, what maximum mass, ***m***, can be suspended from the end of the beam? **(5 marks)**

ANSWER:	Score for Question 3:
b) mass:_____	3. _____ (7)

OVER

4. A 35 kg child rides a ferris wheel of radius 12 m. The child moves in a vertical circle at a constant speed and completes one rotation every 9.0 s.



a) As the child travels over the top, what is the magnitude of the force that the seat exerts on the child? **(5 marks)**

b) How does the magnitude of the child's acceleration at the top of the ride compare to her acceleration at the bottom?

The child's acceleration at the top is: (circle one) **(1 mark)**

i) less than at the bottom.
ii) greater than at the bottom.
iii) the same as at the bottom.

Explain your choice using principles of physics. **(3 marks)**

_____

_____

_____

_____

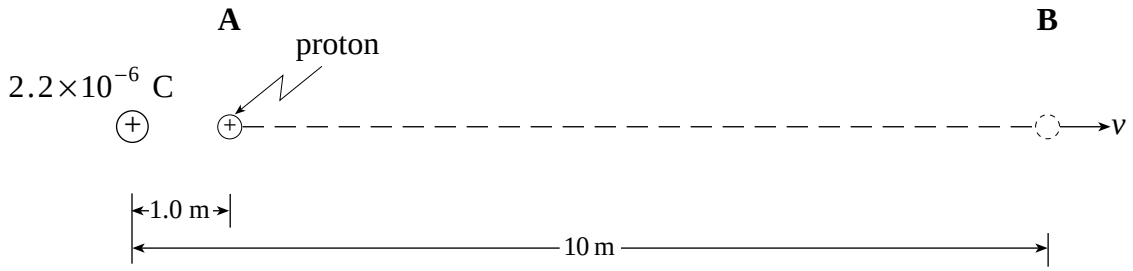
_____

_____

ANSWER:	Score for Question 4:
a) magnitude of force:_____	4. _____ (9)

OVER

5. A proton is located at **A,** 1.0 m from a fixed $+2.2\times10^{-6}$C charge.



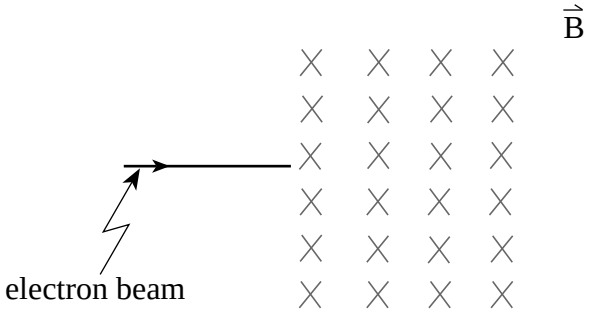
a) What is the change in potential energy of the proton as it moves to **B**, 10 m from the fixed charge? **(5 marks)**

b) If the proton started from rest at **A**, what would be its speed at **B**? **(2 marks)**

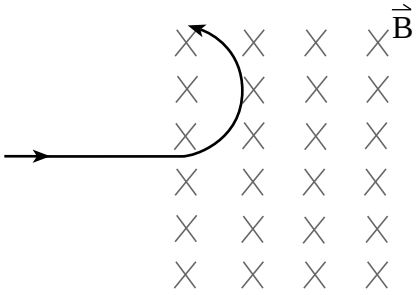
ANSWER:	Score for Question 5:
a) change in potential energy:_____ b) speed:_____	5. _____ (7)

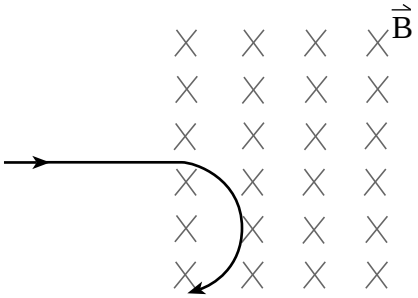
OVER

6. A beam of electrons travelling at $1.8\times10^{8}\,\text{m/s}$ is directed towards a $0.014\,\text{T}$ magnetic field as shown in the diagram below.



a) Which of the following diagrams illustrates the path of the electron beam once in the magnetic field? (Circle one.) **(1 mark)**





b) What is the radius of the path of the electron beam while in the magnetic field? **(6 marks)**

ANSWER:	Score for Question 6:
b) radius:_____	6. _____ (7)

OVER

7. Electrical power is transmitted over large distances at very high voltages. Using principles of physics, explain how high voltages reduce power losses in transmission lines. **(4 marks)**

_____

_____

_____

_____

_____

_____

Score for Question 7:

7. _____ (4)

This is the end of the written-response section.

PART C: ELECTED TOPICS

Value: 12 marks **Suggested Time: 12 minutes**

INSTRUCTIONS

1. Choose **only one** section from the three sections in this part of the examination.

   SECTION I: Quantum Mechanics (p. 28 to 31)

   or

   SECTION II: Fluid Theory (p. 32 to 35)

   or

   SECTION III: AC Circuitry and Electronics (p. 36 to 39)

2. If you answer questions in more than one section, only the answers in the first section chosen will be marked.

3. Answer **all** of the questions in the section that you choose. **Write your answers in the space provided in this booklet.**

4. Rough-work space has been incorporated into the space allowed for answering each question. You may not need all of the space provided to answer each question.

5. 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.

6. Since partial marks will be awarded for a partial solution, it is important that you provide a clear indication of the steps leading to your answer.

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

I have selected SECTION _____.

OVER

SECTION I: Quantum Mechanics

1. What is the energy of a photon of light of wavelength 550 nm? **(3 marks)**

ANSWER:	Score for Question 1:
energy:_____	8. _____ (3)

2. The work function for a metal is 1.65 *e*V. If the incident light has a wavelength of 410 nm, what would be the maximum speed of the emitted photoelectrons at the metal's surface? **(4 marks)**

ANSWER:	Score for Question 2:
maximum speed:_____	9. _____ (4)

OVER

3. What is the momentum of the photon emitted when the electron in a hydrogen atom changes from the $n = 4$ to $n = 1$ state? **(5 marks)**

ANSWER: momentum of photon:_____	Score for Question 3: 10. _____ (5)

END OF SECTION I: Quantum Mechanics

OVER

SECTION II: Fluid Theory

1. A solid uniform cube of unknown material is 0.13 m on a side and has a mass of 2.0 kg. What is the density of this cube? **(3 marks)**

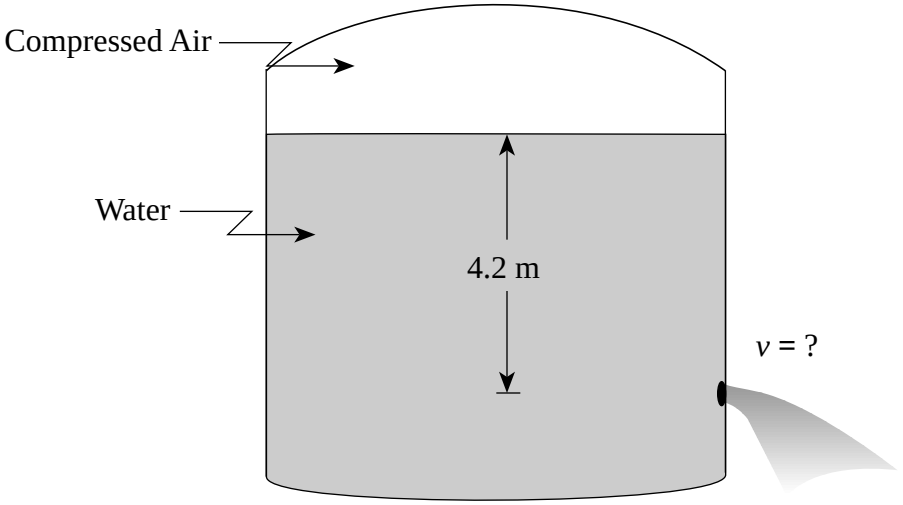
ANSWER:	Score for Question 1:
density:_____	11. _____ (3)

2. A rigid sealed container is filled with a gas. Initially the gas is at a temperature of $28°C$ and at a pressure of 4.0×10^5 Pa. If the gas is then heated to a temperature of $52°C$, what is the new pressure in the container? **(4 marks)**

ANSWER:	Score for Question 2:
pressure:_____	12. _____ (4)

OVER

3. The pressure of the compressed air inside the tank shown below is 1.5×10^4 Pa greater than the outside air pressure. There is a small hole in the side of the tank, 4.2 m below water level.



What is the speed of the water leaving this hole? **(5 marks)**

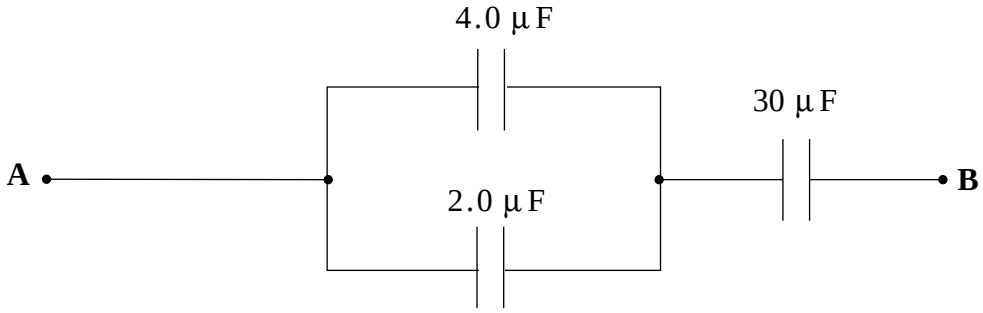
ANSWER: speed:_____	Score for Question 3: 13. _____ (5)

END OF SECTION II: Fluid Theory

OVER

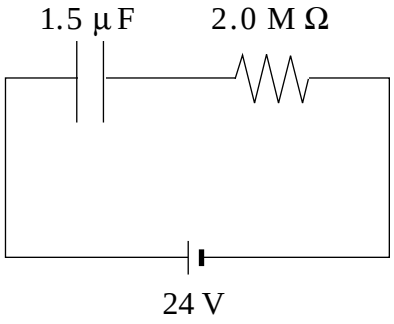
SECTION III: AC Circuitry and Electronics

1. What is the total capacitance between points **A** and **B** in the diagram below? **(3 marks)**



ANSWER:	Score for Question 1:
total capacitance:_____	14. _____ (3)

2. a) What is the time constant for the circuit shown below? **(2 marks)**

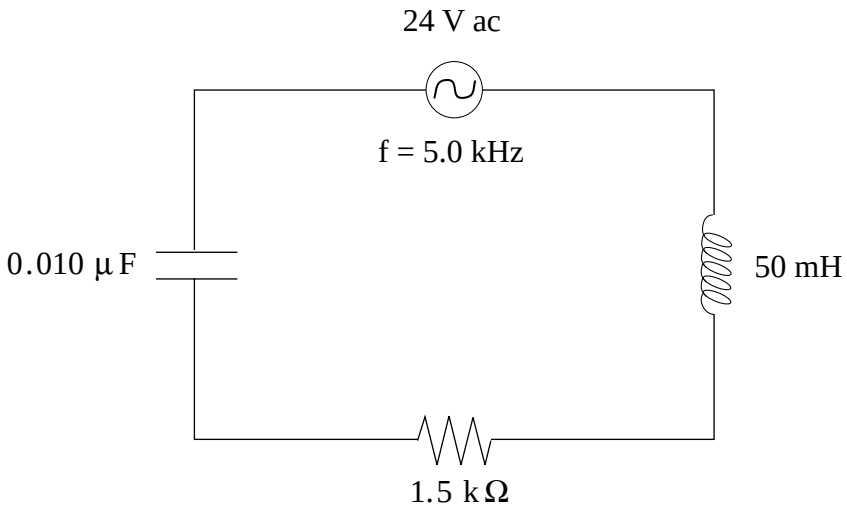


b) What is the voltage across the capacitor when the battery has been connected for one time constant? **(2 marks)**

ANSWER:	Score for Question 2:
a) time constant:_____ b) voltage:_____	15. _____ (4)

OVER

3. What is the impedance of the LCR circuit shown below? **(5 marks)**



ANSWER: impedance:_____	Score for Question 3: 16. _____ (5)

END OF SECTION III: AC Circuitry and Electronics

END OF EXAMINATION

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DATA TABLE

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	$= 4\pi \times 10^{-7}\ \text{T} \cdot \text{m/A}$
Planck's constant	h	$= 6.63 \times 10^{-34}\ \text{J} \cdot \text{s}$
	h	$= 4.14 \times 10^{-15}\ e\text{V} \cdot \text{s}$
Speed of light	c	$= 3.00 \times 10^{8}\ \text{m/s}$
Rydberg's constant	R	$= 1.097 \times 10^{7}\ \text{m}^{-1}$
Unified atomic mass unit	u	$= 1.66 \times 10^{-27}\ \text{kg}$
Boltzmann's constant	k	$= 1.38 \times 10^{-23}\ \text{J/K}$
Gas constant	R	$= 8.31\ \text{J/mol} \cdot \text{K}$
Density of water		$= 1.00 \times 10^{3}\ \text{kg/m}^3$
Density of air		$= 1.29\ \text{kg/m}^3$
Standard atmospheric pressure		$= 1.01 \times 10^{5}\ \text{Pa}$
Volume of one mole of gas at STP		$= 22.4\ \text{L} (2.24 \times 10^{-2}\ \text{m}^3)$
Avogadro's number	N	$= 6.02 \times 10^{23}\ \text{particles/mol}$
Absolute zero		$= -273^\circ\text{C}$

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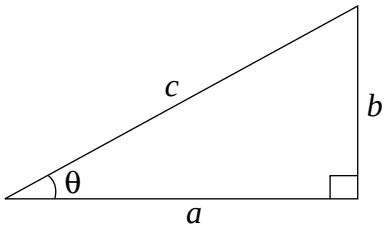
For Right-angled Triangles:

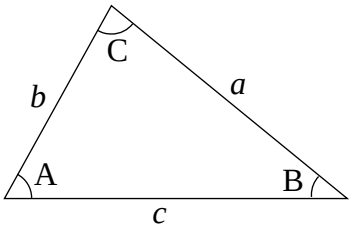


$$a^2 + b^2 = c^2$$

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

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

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:

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

EQUATIONS

Note: Vector quantities have not been indicated.

1. Kinematics: (for constant acceleration)

$v = v_0 + at$ $\qquad v_{av} = \dfrac{v + v_0}{2}$ $\qquad v^2 = {v_0}^2 + 2ad$

$d = v_0 t + \dfrac{1}{2} a t^2$

2. Dynamics:

$F_\mathrm{f} = \mu F_\mathrm{N}$ $\qquad F_\mathrm{net} = ma$

3. Mechanical Energy and Momentum:

$W = Fd$ $\qquad E_\mathrm{p} = mgh$ $\qquad E_\mathrm{k} = \dfrac{1}{2} m v^2$

$P = \dfrac{W}{t}$ $\qquad p = mv$ $\qquad \Delta p = F_\mathrm{net} \Delta t$

4. Equilibrium:

$\tau = Fd$

5. Circular Motion and Gravitation:

$a_\mathrm{c} = \dfrac{v^2}{r} = \dfrac{4\pi^2 r}{T^2}$ $\qquad F = G\dfrac{m_1 m_2}{r^2}$

$E_\mathrm{p} = -G\dfrac{m_1 m_2}{r}$ $\qquad r^3 \propto T^2$

6. Electrostatics:

$F = k\dfrac{Q_1 Q_2}{r^2}$ $\qquad E = \dfrac{V}{d}$ $\qquad V = \dfrac{kQ}{r}$

$E_\mathrm{p} = k\dfrac{Q_1 Q_2}{r}$ $\qquad F = QE$ $\qquad V = \dfrac{\Delta E_\mathrm{p}}{Q}$

7. Circuitry:

$Q = It$ $\qquad V = IR$ $\qquad P = VI$

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8. Electromagnetism:

$F = IlB$ $\quad B = \frac{\mu_0 I}{2\pi d}$ $\quad \tau = NIAB$

$F = QvB$ $\quad B = \mu_0 n I \left(where\ n = \frac{N}{l} \right)$ $\quad \Phi = BA$

$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$ $\quad \mathcal{E} = Blv$ $\quad \frac{V_s}{V_p} = \frac{N_s}{N_p}$

9. Quantum Mechanics: (Section I)

$E = hf$ $\quad c = f\lambda$ $\quad E_n = (-13.6eV)\frac{Z^2}{n^2}$

$E_{k_{max}} = hf - W_0$ $\quad \lambda = \frac{h}{p}$

10. Fluid Theory: (Section II)

$\rho = \frac{m}{V}$ $\quad PV = NkT$ $\quad PV = \frac{1}{3}Nmv^2$

$F = \rho Vg$ $\quad P = \frac{F}{A}$ $\quad P = P_G + P_a$

$PV = nRT$ $\quad P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$ $\quad E_k = \frac{3}{2}kT$

$Av = \text{constant}$

11. AC Circuits and Electronics: (Section III)

$Q = CV$ $\quad E_p = \frac{1}{2}CV^2$ $\quad \tau = RC$

$X_C = \frac{1}{2\pi fC}$ $\quad Z = \sqrt{R^2 + (X_L - X_C)^2}$ $\quad X_L = 2\pi fL$

$f_0 = \frac{1}{2\pi\sqrt{LC}}$ $\quad \beta\ (\text{current gain}) = \frac{\Delta I_C}{\Delta I_B}$ $\quad A_f = \frac{A}{1-\beta A}$

$(\text{where } \beta = \text{ feedback ratio})$

ROUGH WORK FOR MULTIPLE-CHOICE

You may detach this page for convenient reference.
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