INSERT STUDENT I.D. NUMBER

STICKER IN THIS SPACE

JANUARY 1994

PROVINCIAL EXAMINATION

MINISTRY OF EDUCATION

PHYSICS 12

GENERAL INSTRUCTIONS

1. Insert the stickers with your Student I.D. Number 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. 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

   ENDOFEXAMINATION .

5. 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

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_____ – _____

PHYSICS 12 JANUARY 1994 PROVINCIAL
(PHP)

1. _____ (7)

2. _____ (7)

3. _____ (2)

4. _____ (5)

5. _____ (7)

6. _____ (5)

7. _____ (4)

8. _____ (7)

9. _____ (4)

Score **ONLY ONE** of the following optional sections.

SECTION I		SECTION II		SECTION III
10. _____ (3)		13. _____ (3)		16. _____ (3)
11. _____ (4)	**OR**	14. _____ (4)	**OR**	17. _____ (4)
12. _____ (5)		15. _____ (5)		18. _____ (5)

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PHYSICS 12 PROVINCIAL EXAMINATION

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

		Value	Suggested Time
PART A:	30 multiple-choice questions worth two marks each	60	60
PART B:	7 written-response questions	48	48
PART C:	Three sections from which **ONE** section **only** must be chosen.	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 not** be programmable to process alpha-numeric strings nor should it be capable of processing user-defined functions. It **must not** have the capacity to accept coefficients from either an equation or a system of equations, thereby producing the roots of that equation or system. The calculator **must not** contain a plotter or printer.

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

6. a) Numerical answers to problems must contain correct units.
   b) Numerical answers must be calculated 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. Since partial marks will be awarded for a partial solution, it is important that students provide a clear indication of the steps leading to their answers.

   Full marks will NOT be given for providing only a final answer.

8. Students have **two hours** to complete this examination.

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PART A: MULTIPLE-CHOICE QUESTIONS

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 one of the following is a vector quantity?

   A. time
   B. speed
   C. energy
   D. displacement

2. Unless acted on by an external net force, an object will stay at rest or

   A. come to rest.
   B. decelerate at a constant rate.
   C. slow down from a given speed.
   D. continue to move in a straight line at a constant speed.

3. A car is travelling at a constant speed of 26.0 m/s down a slope which is 12.0° to the horizontal. What is the vertical component of the car's velocity?

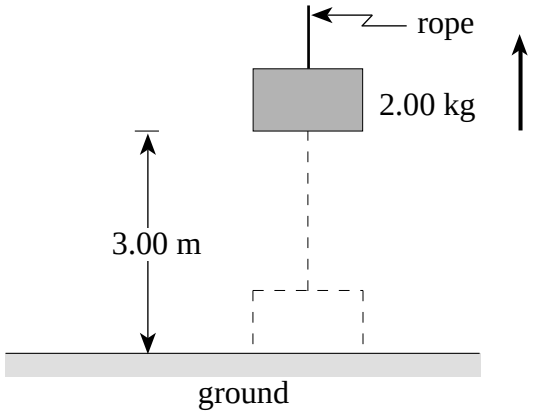
   A. 5.41 m/s
   B. 9.80 m/s
   C. 25.4 m/s
   D. 26.0 m/s

4. A 65.0 kg block is being accelerated along a level surface. The applied force is 500 N and the friction force is 300 N. What is the coefficient of friction between the block and the surface?

   A. 0.31
   B. 0.47
   C. 0.78
   D. 1.30

OVER

5. A 2.00 kg object, initially at rest on the ground, is accelerated vertically by a rope, as shown. The object reaches a height of 3.00 m in 1.50 s.



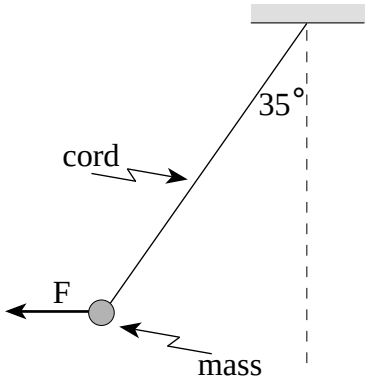
What is the tension in the rope during the acceleration?

A. 5.33 N
B. 14.3 N
C. 23.6 N
D. 24.9 N

6. A 2.0 kg puck travelling due east at 2.5 m/s collides with a 1.0 kg puck travelling due south at 3.0m/s. They stick together on impact. What is the resultant direction of the combined pucks?

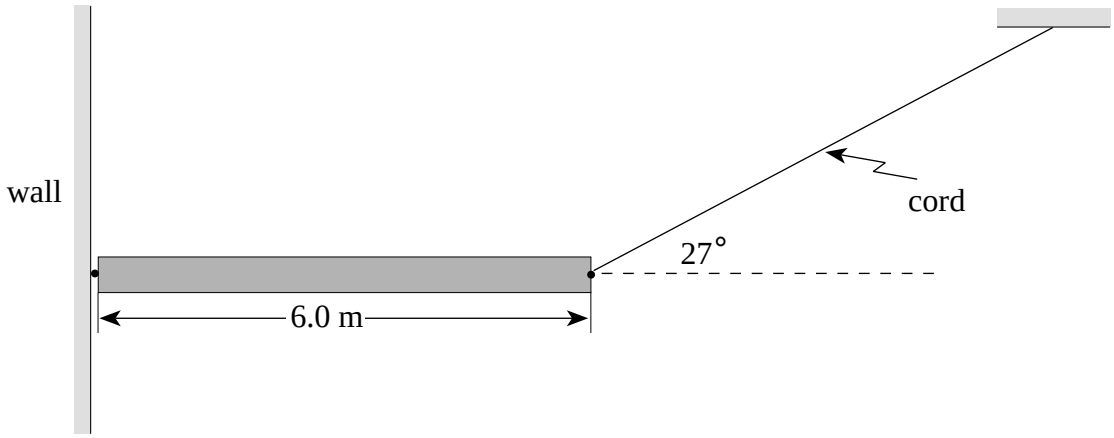
A. 31° S of E
B. 40° S of E
C. 50° S of E
D. 59° S of E

7. A mass of 5.0 kg is suspended from a cord as shown in the diagram below. What horizontal force F is necessary to hold the mass in the position shown?



A. 28 N
B. 34 N
C. 40 N
D. 70 N

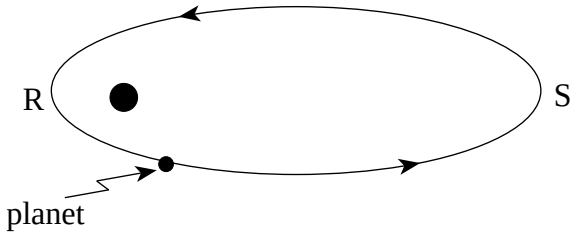
8. A uniform 25 kg bar, 6.0 m long, is suspended by a cord as shown.



What is the tension in the cord?

A. 1.2×10^2 N
B. 2.7×10^2 N
C. 3.7×10^2 N
D. 5.4×10^2 N

9. A planet is in orbit as shown in the diagram below.



The planet's gravitational potential energy will

A. be constant throughout its orbit.
B. always be equal to its kinetic energy.
C. increase as the planet goes from point R to point S.
D. decrease as the planet goes from point R to point S.

10. The gravitational force of attraction between the Sun and an asteroid travelling in an orbit of radius 4.14×10^{11} m is 4.62×10^{17} N. What is the mass of the asteroid?

A. 1.45×10^9 kg
B. 4.08×10^9 kg
C. 4.71×10^{16} kg
D. 6.00×10^{20} kg

OVER

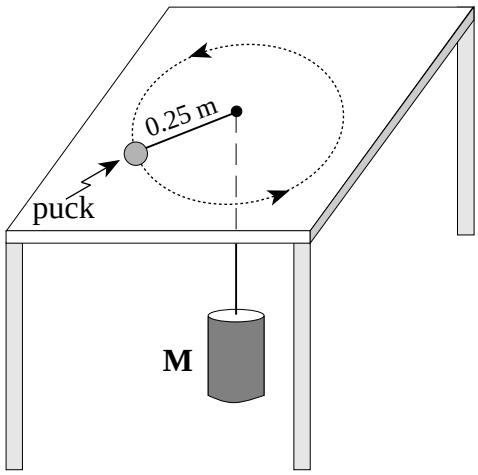
11. The orbital radius of Mars around the Sun is 1.52 times that of Earth's orbital radius. In Earth years, what is the period of revolution for Mars in this orbit?

A. 0.66 years
B. 1.5 years
C. 1.9 years
D. 3.5 years

12. What is the centripetal acceleration of the Moon in its orbit around the Earth?

A. 0 m/s^2
B. 2.7×10^{-3} m/s^2
C. 1.6 m/s^2
D. 9.8 m/s^2

13. A 0.055 kg puck is attached to a 0.150 kg mass **M** by a cord that passes through a hole in a frictionless table, as shown. The puck travels in a circular path of radius 0.25 m.



What is the speed of the puck?

A. 0.61 m/s
B. 0.95 m/s
C. 1.6 m/s
D. 2.6 m/s

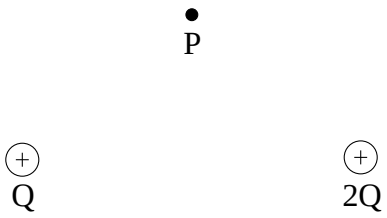
14. Which one of the following represents correct units for electric field strength?

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

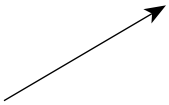
15. The flow of charge per unit time defines

A. power.
B. current.
C. voltage.
D. resistance.

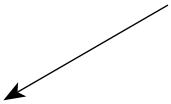
16. The diagram below shows two positive charges of magnitude Q and 2Q.



Which vector **best** represents the direction of the electric field at point P, which is equidistant from both charges?

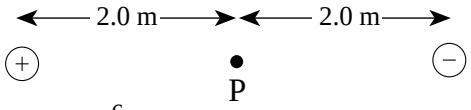
A. 

B. 

C. 

D. 

17. A 6.0×10^{-6} C charge is located 4.0 m from a -3.0×10^{-6} C charge.



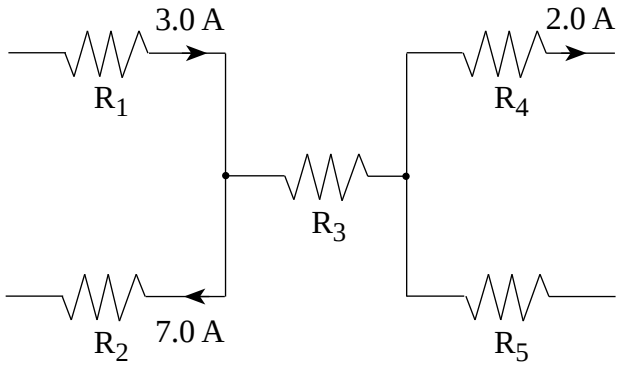
$Q_1 = 6.0 \times 10^{-6}$ C $\qquad$ $Q_2 = -3.0 \times 10^{-6}$ C

What is the electric potential at P, halfway between the charges?

A. -4.1×10^{-2} V
B. 6.8×10^{3} V
C. 1.4×10^{4} V
D. 4.1×10^{4} V

OVER

18. The diagram below shows part of an electrical circuit.



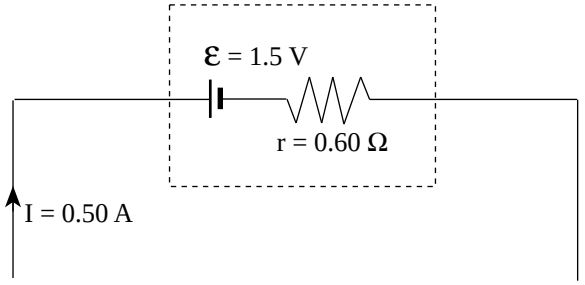
What are the magnitude and direction of the current passing through resistor R_5 ?

A. 6.0 A towards the left
B. 12.0 A towards the left
C. 2.0 A towards the right
D. 8.0 A towards the right

19. A 12 V battery is connected to a 60 Ω resistor. How much charge will flow through the resistor in 20 s?

A. 0.010 C
B. 0.20 C
C. 4.0 C
D. 48 C

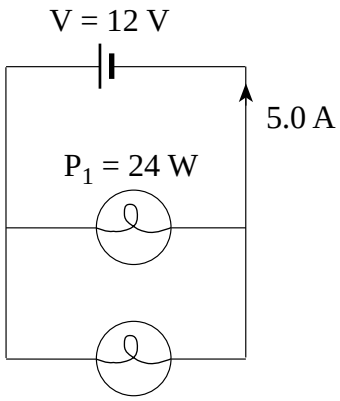
20. A cell whose emf is 1.5 V and internal resistance is 0.60 Ω is charged by supplying a 0.50 A current in the direction shown.



What is the terminal voltage of the cell while being charged?

A. 0.30 V
B. 1.2 V
C. 1.5 V
D. 1.8 V

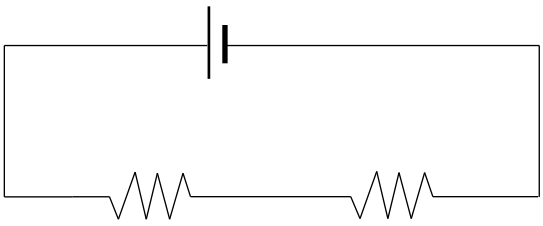
21. A 12 V battery supplies a 5.0 A current to two light bulbs as shown below.

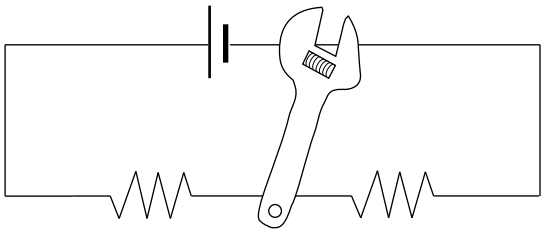


The power output of one of the bulbs is P_1 = 24 W. What is the power output of the other bulb?

A. 14 W
B. 24 W
C. 36 W
D. 60 W

22. A student measures the current through the resistor R_2 to be 3.0 A, as shown in the left-hand diagram.



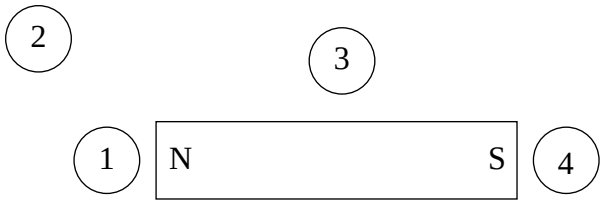


When a wrench that has a small resistance is dropped on the circuit as shown, the current through R_2 is reduced to 1.0 A. What is the current flowing through the wrench? (Assume the supply voltage remains constant.)

A. 1.0 A
B. 2.0 A
C. 5.0 A
D. 7.5 A

OVER

23. A compass is placed in each of the four locations around a permanent bar magnet as shown below.



In which location would the North pole of the compass needle point to the right side of the page?

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

24. A square coil is perpendicular to a uniform magnetic field. Which one of the following would **increase** the magnetic flux through the coil?

A. Decreasing the area of the coil.
B. Increasing the number of loops in the coil.
C. Removing the coil from the magnetic field.
D. Increasing the strength of the magnetic field.

25. A charge X is placed in an electric field and a second charge Y is placed in a magnetic field. If both charges are initially held at rest, which one of the following **best** describes the motion of the charges after they are released? (Ignore gravitational effects.)

A. Charge X accelerates.
B. Charge Y accelerates.
C. Both charge X and charge Y accelerate.
D. Neither charge X nor charge Y accelerates.

26. Two straight parallel wires are separated by 1.60 m. The first wire carries a current of 95.0 A, and the magnetic field produced by this current exerts a force of 2.50×10^{-3} N on a 2.00 m length of the second wire. What is the current in the second wire?

A. 20.9 A
B. 105 A
C. 132 A
D. 164 A

27. A coil of wire of area $1.5 \times 10^{-3}\ m^2$ consists of 40 loops. A magnetic field is perpendicular to the face of the coil. In a period of 0.20 s the strength of the magnetic field decreases from 0.060T to0.050T in the same direction. What is the average emf induced in the coil during this time?

A. 7.5×10^{-5} V
B. 1.5×10^{-3} V
C. 3.0×10^{-3} V
D. 3.3×10^{-2} V

28. The current in an electric motor running at full speed is 2.5 A when connected to an 80 V dc source. If the armature resistance of the motor is 4.0 Ω, what is the back emf at this speed?

A. 0 V
B. 10 V
C. 70 V
D. 90 V

29. An ideal transformer has 150 turns in the primary coil and 1 800 turns in the secondary coil. If the primary coil is connected to 120 V ac and draws 7.5 A of current, what is the current in the secondary coil?

A. 0.63 A
B. 7.5 A
C. 16 A
D. 90 A

30. An electron moves in a circular orbit of radius r in a magnetic field. The electron moves in a path perpendicular to the magnetic field. If the kinetic energy of the electron is doubled, what is the new radius of its path?

A. $\frac{1}{2}$ r
B. $\sqrt{2}$ r
C. 2 r
D. 4 r

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: PROBLEMS

Value: 48 marks **Suggested Time: 48 minutes**

INSTRUCTIONS: 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. Your numerical answers to problems must contain correct units where appropriate, and must be calculated to two or three significant figures. 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 providing only a final answer.

OVER

1. A 1.50 kg projectile is launched at 18.0 m/s from level ground. The launch angle is 26.0° above the horizontal. (Assume negligible friction.)

   a) What is the maximum height reached by this projectile? **(5 marks)**

b) How fast will the projectile be travelling when it is at its maximum height? **(2 marks)**

ANSWERS:	Score for Question 1:
a) height: _____	1. _____ (7)
b) speed: _____	

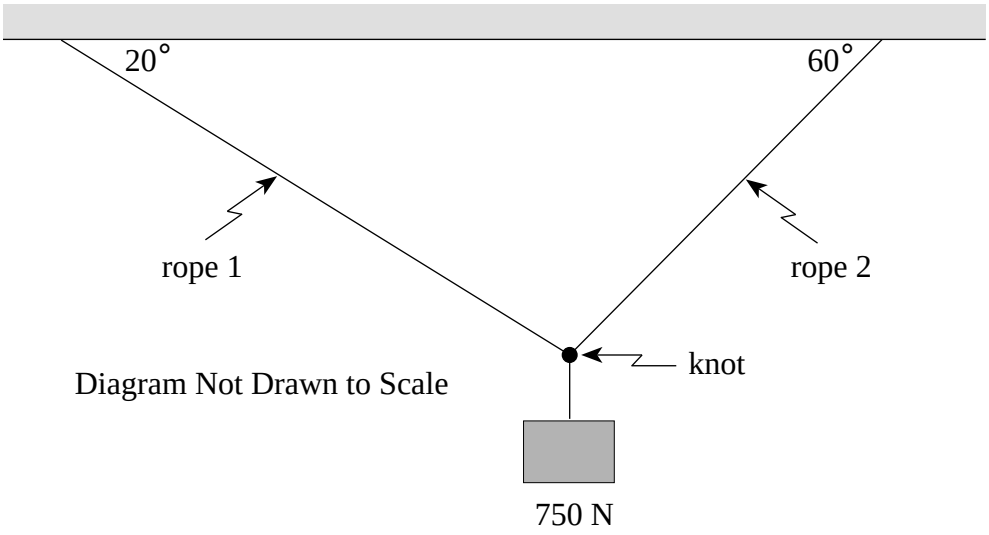
OVER

2. A 5.20 kg block sliding at 9.40 m/s across a horizontal frictionless surface collides head on with a stationary 8.60 kg block. The 5.20 kg block rebounds at 1.80 m/s. How much kinetic energy is lost during this collision? **(7 marks)**

ANSWER:	Score for Question 2:
energy lost: _____	2. _____ (7)

OVER

3. A 750 N weight is supported by two ropes fastened together by a knot, as shown in the diagram below.



a) Draw a free-body diagram showing the forces acting on the knot. **(2 marks)**

Score for Question 3a:
3. _____ (2)

b) What is the tension in rope 1? **(5 marks)**

ANSWER:	Score for Question 3b:
tension: _____	4. _____ (5)

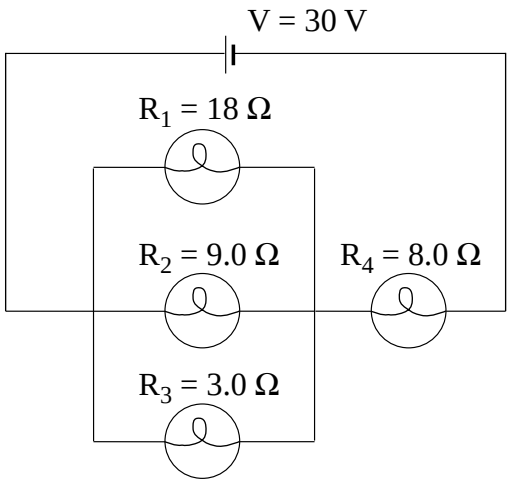
OVER

4. A satellite travels in a circular orbit at a height of one Earth radius above the surface of the Earth. What is the satellite's orbital period? **(7 marks)**

ANSWER:	Score for Question 4:
orbital period: _____	5. _____ (7)

OVER

5. a) Find the current in the 8.0 Ω bulb shown below. **(5 marks)**



ANSWER:	Score for Question 5a:
current:_____	6. _____ (5)

b) (i) The 3.0 Ω bulb is removed from the circuit so that only 3 bulbs remain.
The 8.0 Ω bulb will now: **(Circle one)** **(1 mark)**

A. be dimmer.
B. be brighter.
C. remain the same.

(ii) Using principles of electrical circuits, explain your answer to b(i). **(3 marks)**

_____

_____

_____

_____

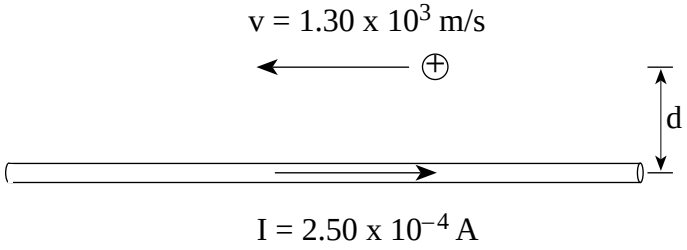
_____

_____

Score for Question 5b:
7. _____ (4)

OVER

6. A proton with a speed of 1.30×10^{3} m/s travels parallel to a horizontal wire carrying a current of 2.50×10^{-4} A as shown.



If the magnetic force on the proton is 1.64×10^{-26} N, at what distance **d** is the proton travelling above the wire? **(7 marks)**

ANSWER:	Score for Question 6:
distance: _____	8. _____ (7)

OVER

7. Two gliders having equal masses, each travelling along a level frictionless track at the same speed, approach each other head on. They stick together on impact and remain stationary at the point of impact. Does this situation mean that momentum has been lost during this particular collision? State your answer with supporting arguments which use principles of physics. **(4 marks)**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Score for Question 7:
9. _____ (4)

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 Physics (p. 26 to 28)

   OR

   SECTION II: Fluid Theory (p. 29 to 31)

   OR

   SECTION III: AC Circuitry and Electronics (p. 32 to 35)

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

3. Do **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. Your numerical answers to problems must contain correct units where appropriate, and must be calculated to two or three significant figures.

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

   Full marks will not be given for providing only a final answer.

I have selected SECTION _____.

OVER

SECTION I: Quantum Physics

1. What is the momentum of an electron whose de Broglie wavelength is 1.46×10^{-10} m? **(3 marks)**

ANSWER:	Score for Question 1:
momentum: _____	10. _____ (3)

2. An electron in the second level (n = 2) of an atom has an energy of –30.6 eV. How many protons does this atom have in its nucleus? (Express your answer as a whole number.) **(4 marks)**

ANSWER:	Score for Question 2:
number of protons: _____	11. _____ (4)

OVER

3. An electron is in the sixth excited state (n = 7) of a hydrogen atom. When it makes a transition to a lower energy level, the emitted photon has a wavelength of 1.01×10^{-6} m. What is the quantum number of the lower energy level? (Express your answer as a whole number.) **(5 marks)**

ANSWER:	Score for Question 3:
quantum number:_____	12. _____ (5)

END OF SECTION I: Quantum Physics

SECTION II: Fluid Theory

1. A glass bottle of soda is sealed with a screw cap. The gauge pressure inside the bottle is 4.90×10^4 Pa. The area of the bottom of the screw cap is 1.20×10^{-3} m^2. What force must the screw threads exert on the glass to keep the cap in place? **(3 marks)**

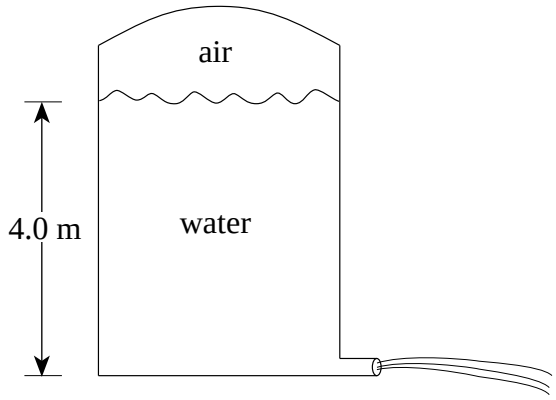
ANSWER:	Score for Question 1:
force: _____	13. _____ (3)

OVER

2. At the start of a trip, the absolute pressure in a car's tires is measured to be 2.91×10^5 Pa at a temperature of 10° C. At the end of the trip, the absolute pressure is measured to be 3.11×10^5 Pa. Neglecting the expansion of the tires, what is the temperature (in degrees Celsius) inside the tires at the end of the trip? **(4 marks)**

ANSWER:	Score for Question 2:
temperature: _____	14. _____ (4)

3. In a closed tank, the gauge pressure of the air above the water is 5.00×10^5 Pa. The water leaves the tank through a nozzle 4.0 m below the surface of the water as shown.



What is the speed at which the water leaves the nozzle? **(5 marks)**

ANSWER:	Score for Question 3:
speed: _____	15. _____ (5)

END OF SECTION II: Fluid Theory

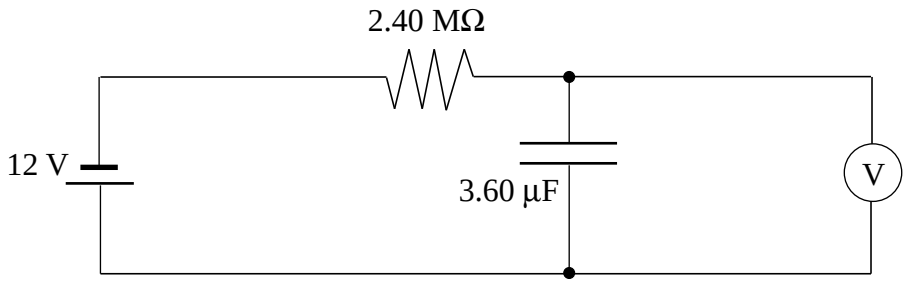
OVER

SECTION III: AC Circuitry and Electronics

1. In a certain transistor the collector current changes from 1.20 mA to 1.75 mA when the base current varies from 4.6 μA to 8.6 μA. What is the current gain for this transistor? **(3 marks)**

ANSWER:	Score for Question 1:
current gain:_____	16. _____ (3)

2. A 2.40 MΩ resistor and a 3.60 μF capacitor are connected in an RC circuit as shown.



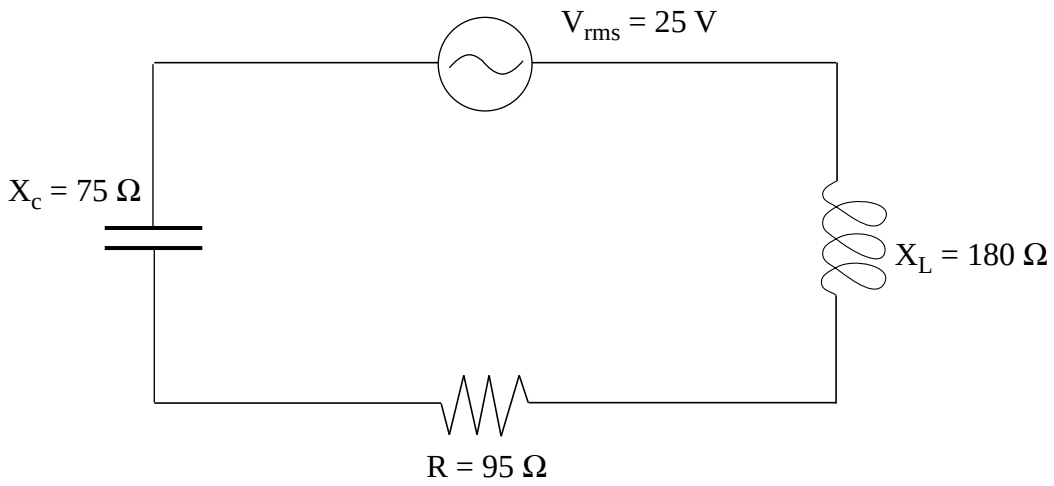
a) What is the time constant for this circuit? **(2 marks)**

b) What is the charge stored in the capacitor at the instant the voltmeter reads 9.00 V? **(2 marks)**

ANSWERS:	Score for Question 2:
time constant: _____	17. _____ (4)
charge:_____	

OVER

3. A series circuit has a resistance of 95 Ω, an inductive reactance of 180 Ω and a capacitive reactance of 75 Ω.



a) If the coil has an inductance of 35.0 mH, what is the applied frequency? **(2 marks)**

b) What current flows in the circuit? **(3 marks)**

ANSWERS:	Score for Question 3:
applied frequency: _____	
current: _____	18. _____ (5)

END OF SECTION III: AC Circuitry and Electronics

END OF EXAMINATION

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DATA TABLE

Pi	π	$= 3.14$
Gravitational constant	G	$= 6.67 \times 10^{-11}$ N•m^2/kg^2
Acceleration due to gravity at the surface of Earth (for the purposes of this examination)	g	$= 9.80$ m/s^2
Earth		
radius		$= 6.38 \times 10^{6}$ m
radius of orbit about Sun		$= 1.50 \times 10^{11}$ m
period of rotation		$= 8.61 \times 10^{4}$ s
period of revolution about Sun		$= 3.16 \times 10^{7}$ s
mass		$= 5.98 \times 10^{24}$ kg
Moon		
radius		$= 1.74 \times 10^{6}$ m
radius of orbit about Earth		$= 3.84 \times 10^{8}$ m
period of rotation		$= 2.36 \times 10^{6}$ s
period of revolution about Earth		$= 2.36 \times 10^{6}$ s
mass		$= 7.35 \times 10^{22}$ kg
Sun		
mass		$= 1.98 \times 10^{30}$ kg
Constant in Coulomb's Law	k	$= 9.00 \times 10^{9}$ N•m^2/C^2
Elementary charge	e	$= 1.60 \times 10^{-19}$ C
Mass of electron	m_e	$= 9.11 \times 10^{-31}$ kg
Mass of proton	m_p	$= 1.67 \times 10^{-27}$ kg
Mass of neutron	m_n	$= 1.68 \times 10^{-27}$ kg
Permeability of free space	μ_o	$= 4\pi \times 10^{-7}$ T• m/A
Planck's constant	h	$= 6.63 \times 10^{-34}$ J•s
	h	$= 4.14 \times 10^{-15}$ eV•s
Speed of light	c	$= 3.00 \times 10^{8}$ m/s
Rydberg's constant	R	$= 1.097 \times 10^{7}$ m^{-1}
Unified atomic mass unit	u	$= 1.66 \times 10^{-27}$ kg
Boltzmann's constant	k	$= 1.38 \times 10^{-23}$ J/K
Gas constant	R	$= 8.31$ J/mol•K
Density of water		$= 1.00 \times 10^{3}$ kg/m^3
Density of air		$= 1.29$ kg/m^3
Standard atmospheric pressure		$= 1.01 \times 10^{5}$ Pa
Volume of one mole of gas at STP		$= 22.4$ L (2.24×10^{-2} m^3)
Avogadro's number	N	$= 6.02 \times 10^{23}$ particles/mol
Absolute zero		$= -273$ ˚C

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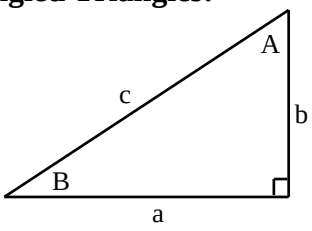
For Right-angled Triangles:

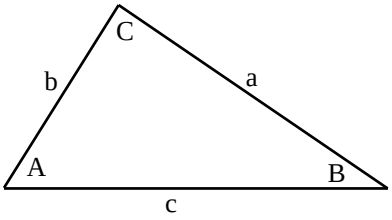


$a^2 + b^2 = c^2$

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

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

For All Triangles:



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

$\sin 2A = 2\sin A \cos A$

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

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

Circle:

$\text{Circumference} = 2\pi r$

$\text{Area} = \pi r^2$

Sphere:

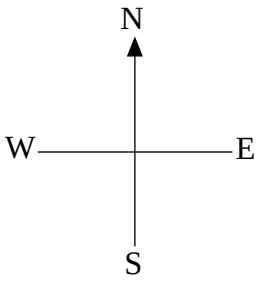
$\text{Surface area} = 4\pi r^2$

$\text{Volume} = \frac{4}{3}\pi r^3$

Prefixes:

giga	$(G) = 10^9$	milli	$(m) = 10^{-3}$
mega	$(M) = 10^6$	micro	$(\mu) = 10^{-6}$
kilo	$(k) = 10^3$	nano	$(n) = 10^{-9}$
centi	$(c) = 10^{-2}$	pico	$(p) = 10^{-12}$

Relative Compass Directions:



Quadratic Equation:

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

EQUATIONS

1. Vector Kinematics: (for constant acceleration)

$\vec{v} = \vec{v}_0 + \vec{a}t$ $\quad$ $\vec{v}_{av} = \frac{v + v_0}{2}$ $\quad$ $v^2 = {v_0}^2 + 2ad$

$\vec{d} = \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$

2. Vector Dynamics:

$F_f = \mu F_N$ $\quad$ $\vec{F}_{net} = m\vec{a}$

3. Mechanical Energy and Vector Momentum:

$W = Fd$ $\quad$ $E_p = mgh$ $\quad$ $E_k = \frac{1}{2}mv^2$

$P = \frac{W}{\Delta t}$ $\quad$ $\vec{p} = m\vec{v}$ $\quad$ $\Delta\vec{p} = \vec{F}_{net}\Delta t$

4. Equilibrium:

$\tau = Fd$

5. Circular Motion and Gravitation:

$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$ $\quad$ $F = G\frac{m_1 m_2}{r^2}$

$E_p = -G\frac{m_1 m_2}{r}$ $\quad$ $r^3 \propto T^2$

6. Electrostatics:

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

$E_p = k\frac{Q_1 Q_2}{r}$ $\quad$ $\vec{F} = Q\vec{E}$ $\quad$ $V = \frac{\Delta E_p}{Q}$

7. Circuitry:

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

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8. Electromagnetism:

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

$F = QvB$ $\quad B = \mu_0 \frac{N}{l} I$ $\quad \Phi = BA$

$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$ $\quad B = \mu_0 nI \left(\text{where } n = \frac{N}{l}\right)$ $\quad \frac{V_s}{V_p} = \frac{N_s}{N_p}$

$\mathcal{E} = Blv$

9. Quantum Mechanics: (Section I)

$E(\text{energy}) = hf$ $\quad c = f\lambda$ $\quad W_0 = hf_0$

$E_{k_{max}} = hf - W_0$ $\quad \lambda = \frac{h}{p}$ $\quad E_n = (-13.6eV)\frac{Z^2}{n^2}$

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

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