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Physics 12

AUGUST 2002

Course Code = PH

Student Instructions

1. Place 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.

Question 1:

1. .

(7)

Question 8:

8. .

(5)

Question 2:

2. .

(7)

Question 9:

9. .

(4)

Question 3:

3. .

(7)

Question 4:

4. .

(7)

Question 5:

5. .

(9)

Question 6:

6. .

(7)

Question 7:

7. .

(7)

PHYSICS 12

AUGUST 2002

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

- | | Value | Suggested Time |
|---|---------------|--------------------|
| 1. This examination consists of two parts: | | |
| PART A: 30 multiple-choice questions worth two marks each | 60 | 60 |
| PART B: 9 written-response questions | 60 | 60 |
| | Total: | 120 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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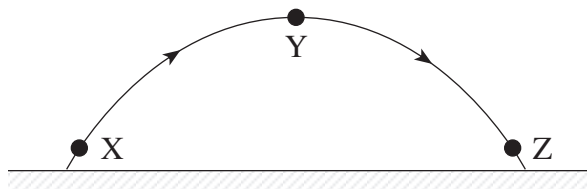
PART A: MULTIPLE CHOICE

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. Consider three points in the path of a certain projectile as shown in the diagram below.



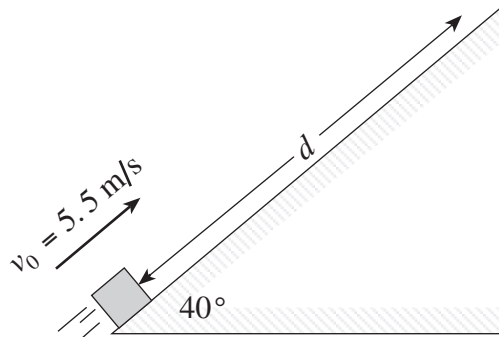
What is the acceleration of the projectile at each of these points?

ACCELERATION (m/s^2)			
	At X	At Y	At Z
A.	+9.8	0	-9.8
B.	+9.8	0	+9.8
C.	-9.8	0	-9.8
D.	-9.8	-9.8	-9.8

2. A projectile is launched over level ground with an initial velocity of 65 m/s at 30° above the horizontal. What is the projectile's time of flight?

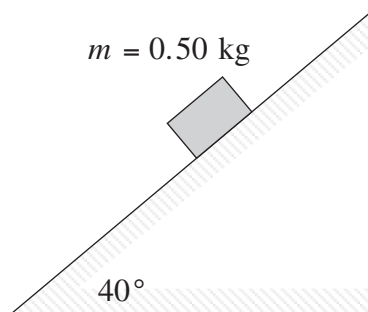
- A. 3.6 s
- B. 6.6 s
- C. 11 s
- D. 13 s

3. A block is launched up the frictionless incline in the diagram below with an initial speed of 5.5 m/s.



What is the maximum displacement, d , of the block up the incline?

- A. 0.44 m
 - B. 0.87 m
 - C. 1.5 m
 - D. 2.4 m
4. Which of the following are units for gravitational field strength?
- A. kg/m
 - B. $\text{kg} \cdot \text{m/s}^2$
 - C. N/kg
 - D. N/kg^2
5. The block shown in the diagram below remains at rest.



What is the friction force acting on the block?

- A. 0 N
- B. 3.1 N
- C. 3.8 N
- D. The friction force cannot be calculated.

6. Which of the following best represents the work-energy theorem?

- A. $W = \Delta E$
- B. $E_k = E_p$
- C. $W = F_f \times d$
- D. $E_p = P \times t$

7. A 1500 kg car moving at 8.0 m/s comes to a stop in 16 m when its brakes are applied. The speed of the car is now doubled to 16 m/s. Assuming the same braking force as before, how far will the car travel before coming to a stop?

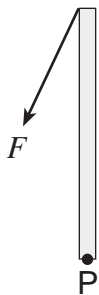
- A. 16 m
- B. 32 m
- C. 64 m
- D. 130 m

8. The momentum of a male Olympic sprinter is about

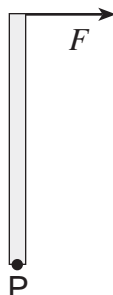
- A. 10 kg · m/s
- B. 100 kg · m/s
- C. 1000 kg · m/s
- D. 10 000 kg · m/s

9. In which of the following situations does force F produce a counter-clockwise torque about point P ?

A.



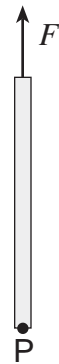
B.



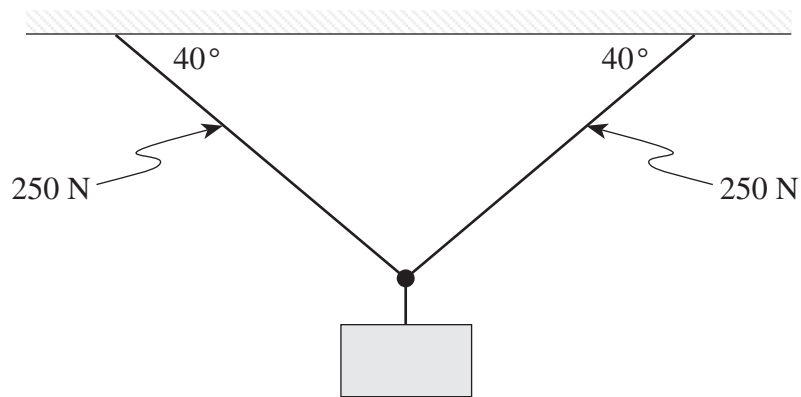
C.



D.

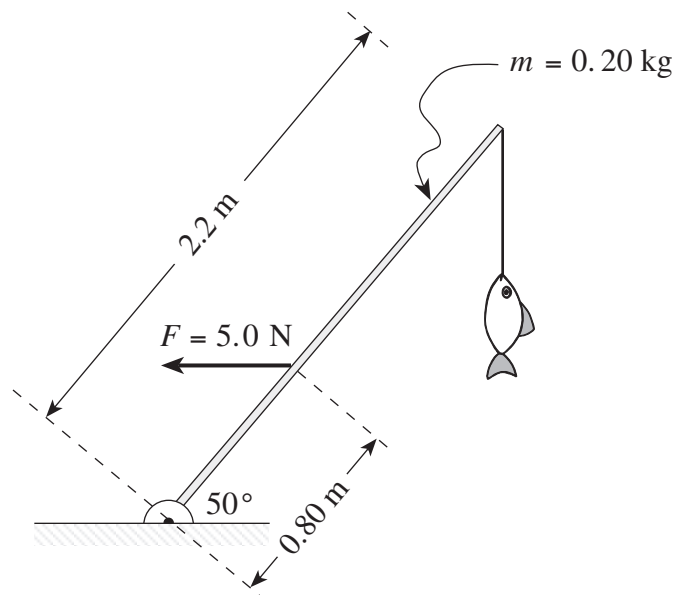


10. An object is suspended by cords as shown in the diagram below.



If the tension in two of the cords is 250 N, what is the weight of the object?

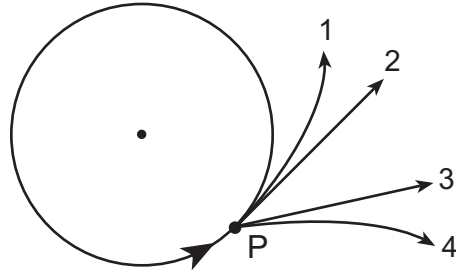
- A. 160 N
 - B. 320 N
 - C. 380 N
 - D. 500 N
11. As shown in the diagram below, a horizontally applied force of 5.0 N is required to hold a fish at the end of a uniform 0.20 kg fishing rod.



What is the weight of the fish?

- A. 0.84 N
- B. 1.2 N
- C. 2.2 N
- D. 3.2 N

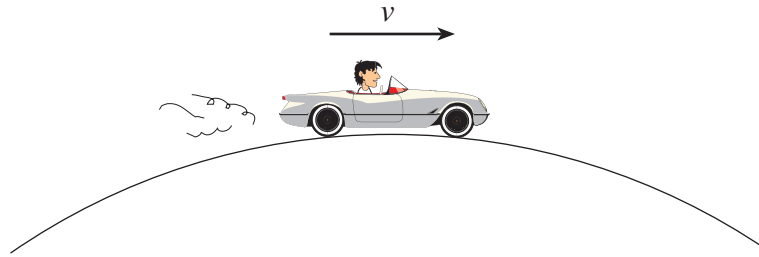
12. When an object moving in a horizontal circle breaks free at point P, it will follow which path?



Viewed from above

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

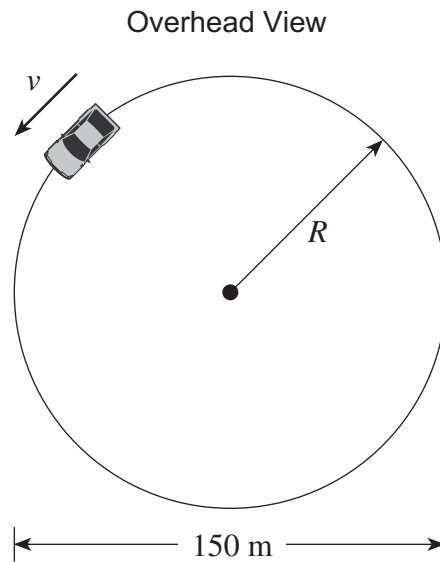
13. A vehicle and driver travel at constant speed over the hill as shown.



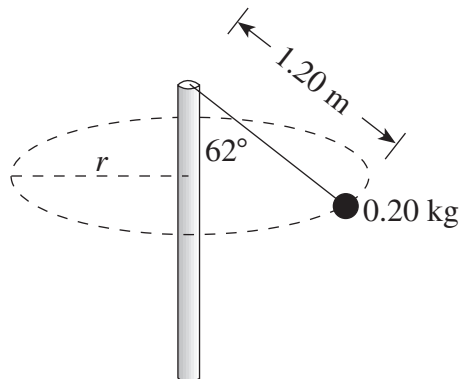
Which of the following free body diagrams best describes the vehicle at this position?

- A.
- B.
- C.
- D.

14. What is the maximum speed a car can travel along a level circular path (as shown below) if the coefficient of friction is 0.86?



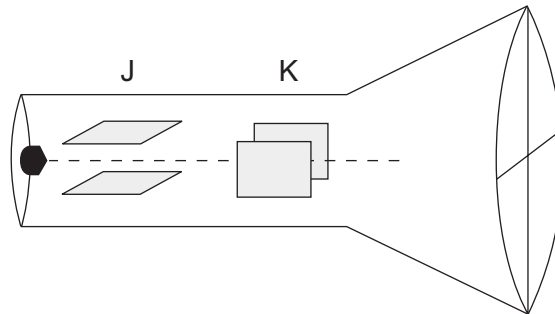
- A. 4.1 m/s
 - B. 8.0 m/s
 - C. 25 m/s
 - D. Depends on the mass of the car
15. A 0.20 kg object moves at a constant speed in a horizontal circular path as shown.



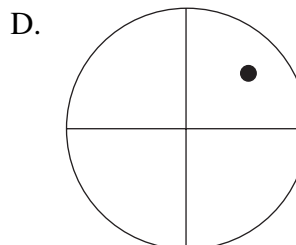
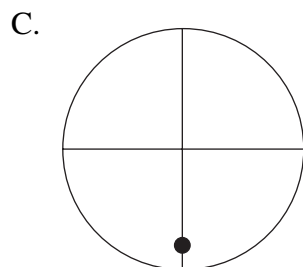
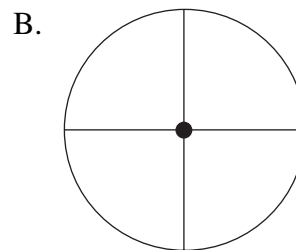
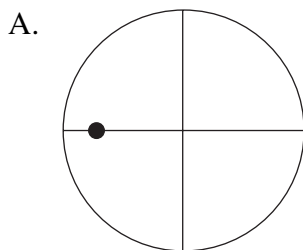
What is the speed of this object?

- A. 2.3 m/s
- B. 3.2 m/s
- C. 3.4 m/s
- D. 4.4 m/s

16. A 2.0×10^3 kg satellite is in a circular orbit around the earth. The satellite has a speed of 3.6×10^3 m/s at an orbital radius of 3.1×10^7 m. What is the total energy of this orbiting satellite?
- A. -2.6×10^{10} J
 B. -1.3×10^{10} J
 C. 1.3×10^{10} J
 D. 3.9×10^{10} J
17. What is the change in gravitational potential energy as a 3500 kg object is raised vertically from the surface of the earth to a height of 8.2×10^5 m?
- A. 5.5×10^7 J
 B. 2.5×10^{10} J
 C. 2.8×10^{10} J
 D. 1.9×10^{11} J
18. In the CRT shown below, a potential difference is only applied to the set of plates at J.



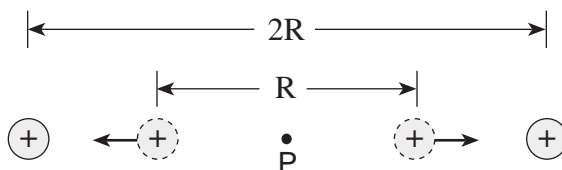
Which of the following could show the position of the electron beam on the screen?



19. In one model of the hydrogen atom, the electron orbits the proton at a distance of 5.1×10^{-11} m. What is the electrostatic force between these two particles?

- A. 3.9×10^{-47} N
- B. 5.3×10^{-27} N
- C. 4.5×10^{-18} N
- D. 8.9×10^{-8} N

20. Two equal positive point charges are placed at distance R from each other. They are then moved to a distance of 2R away from each other. The electric potential and electric field at point P midway between the charges are measured before and after the move.



Which of the following is correct?

	NEW ELECTRIC POTENTIAL	NEW ELECTRIC FIELD
A.	half the original electric potential	half the original electric field
B.	same as the original electric potential	half the original electric field
C.	half the original electric potential	same as the original electric field
D.	same as the original electric potential	same as the original electric field

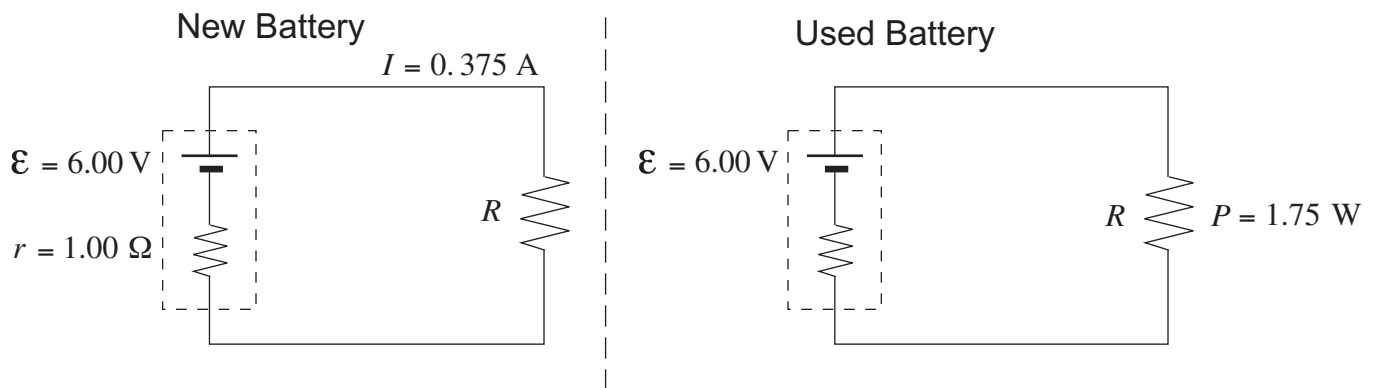
21. What happens to the total resistance of a circuit as one more resistor is added in parallel?

- A. The total resistance decreases.
- B. The total resistance increases.
- C. The total resistance becomes zero.
- D. The total resistance does not change.

22. The headlights in a car use 95 W of power. A driver parks her car but leaves the lights on. The 12 V battery has 3.4×10^5 C of stored charge. How long does it take for the battery to lose its charge?

- A. 1.1×10^3 s
- B. 3.6×10^3 s
- C. 4.3×10^4 s
- D. 2.7×10^6 s

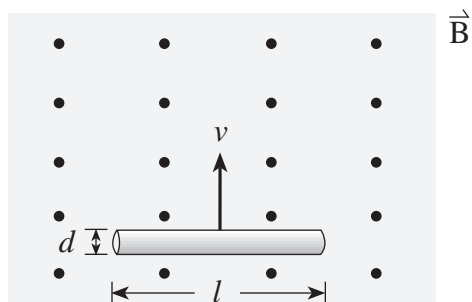
23. A circuit using a new battery which has an emf of 6.00 V and an internal resistance of 1.00 Ω is shown on the left. The battery is then replaced with a used one that has the same emf of 6.00 V but a different internal resistance.



If resistor R now dissipates 1.75 W, what is the internal resistance of the used battery?

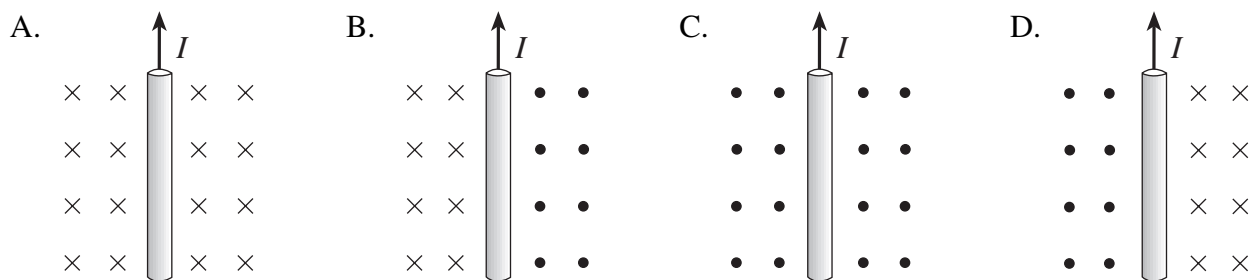
- A. 1.00 Ω
- B. 2.57 Ω
- C. 3.55 Ω
- D. 5.60 Ω

24. A length of conducting wire is moving perpendicular to a magnetic field as shown below.



Which of the following does not affect the size of the emf produced between the ends of the wire?

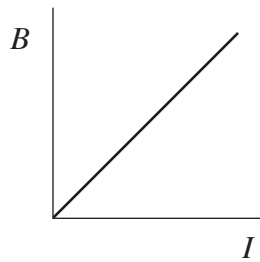
- A. speed of wire
 - B. length of wire
 - C. thickness of wire
 - D. magnetic field strength
25. Which of the four diagrams below correctly depicts the magnetic field found on either side of a current carrying wire?



26. Charged particles having momentum p_1 , pass perpendicularly through a magnetic field and their circular path has a radius of r . What would the radius be for particles with the same charge having momentum $p_2 = 2p_1$?

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

27. The current through a solenoid is varied and the resulting magnetic field at its centre is recorded in each case. A graph of the magnetic field versus the current is produced.



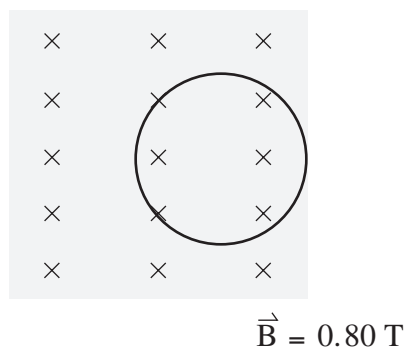
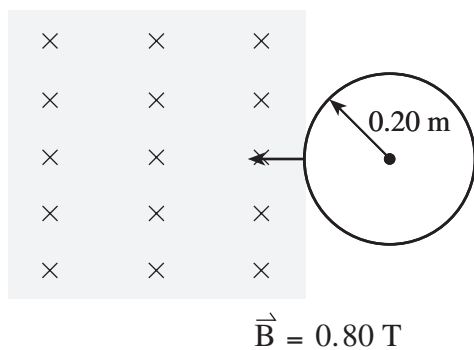
Which of the following represents the slope of this graph?

- A. $\frac{\mu_0 N}{l}$
- B. $\frac{Nl}{\mu_0}$
- C. $\frac{\mu_0 B}{N}$
- D. $\frac{Il}{N}$
28. A refrigerator condenser motor draws a 10 A current at startup (armature not rotating) when attached to a 110 V source. When the motor is operating at normal speed the current is 0.20 A. What back emf is the motor producing at this normal speed?
- A. 100 V
- B. 108 V
- C. 110 V
- D. 112 V
29. The secondary coil in an ideal transformer has 5 times as many windings as the primary. If the current in the primary is 0.40 A, determine the current in the secondary, and the type of the transformer.

	CURRENT IN SECONDARY	TYPE OF TRANSFORMER
A.	0.080 A	step-up
B.	0.080 A	step-down
C.	2.0 A	step-up
D.	2.0 A	step-down

OVER

30. A circular loop of resistance 1.2Ω is pulled a distance of 0.40 m into a perpendicular magnetic field as shown below.



An average current of 0.50 A is produced in the coil during this event. Calculate the constant speed with which the coil was pulled.

- A. 0.10 m/s
- B. 0.75 m/s
- C. 1.9 m/s
- D. 2.4 m/s

This is the end of the multiple-choice section.
Answer the remaining questions directly in this examination booklet.

PART B: WRITTEN RESPONSE

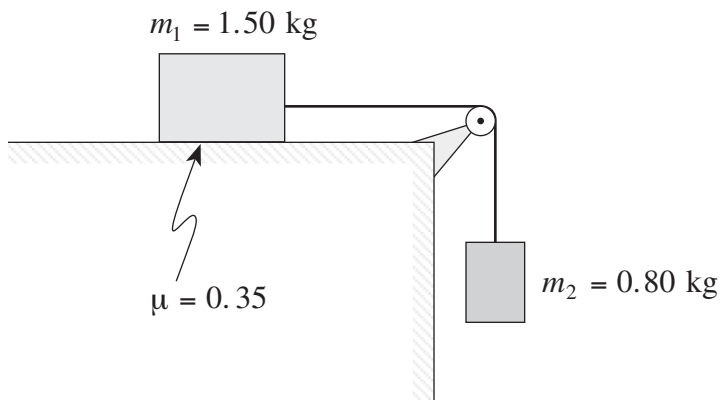
Value: 60 marks

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.**

1. Two masses are connected by a light string passing across a frictionless pulley as shown in the diagram below. The coefficient of friction between mass m_1 and the horizontal surface is 0.35.



- a) Draw and label a free body diagram showing the forces acting on mass m_1 . **(2 marks)**

b) What is the tension in the connecting string?

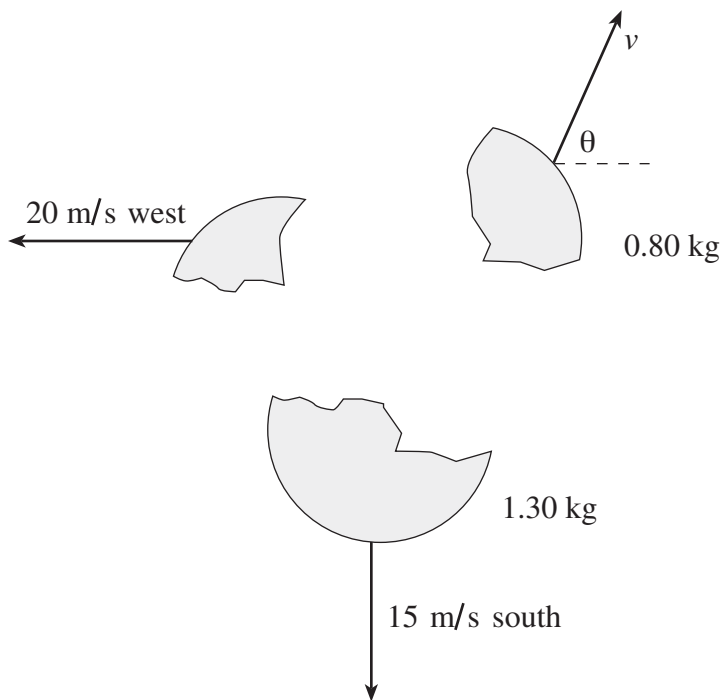
(5 marks)

ANSWER:

b) tension: _____

OVER

2. A 3.00 kg object initially at rest explodes into three fragments as shown in the diagram below.



What are the speed and direction of the 0.80 kg fragment?

(7 marks)

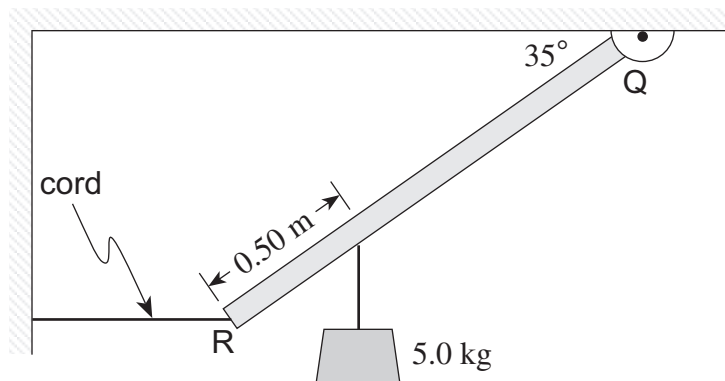
ANSWER:

speed: _____

direction, θ : _____

OVER

3. A uniform 2.4 m beam RQ has a mass of 3.0 kg. The beam is hinged at Q and held in place by a horizontal cord attached at R. A 5.0 kg mass is suspended 0.50 m from R.



What is the tension in the horizontal cord?

(7 marks)

ANSWER:

tension: _____

OVER

4. A 720 kg communication satellite is in synchronous orbit around the planet Mars. This synchronous orbit matches the period of rotation so that the satellite appears to be stationary over a position on the equator of Mars. What is the orbital radius of this satellite? **(7 marks)**

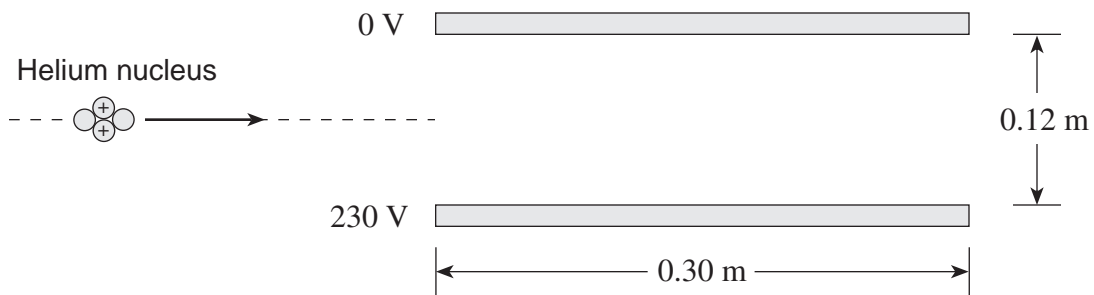
Planetary Data for Mars	
Mass:	$6.42 \times 10^{23} \text{ kg}$
Period of rotation:	$8.86 \times 10^4 \text{ s}$

ANSWER:

orbital radius: _____

OVER

5. A helium nucleus having twice the charge and four times the mass of a proton is travelling with high velocity when it enters a set of charged plates as shown.



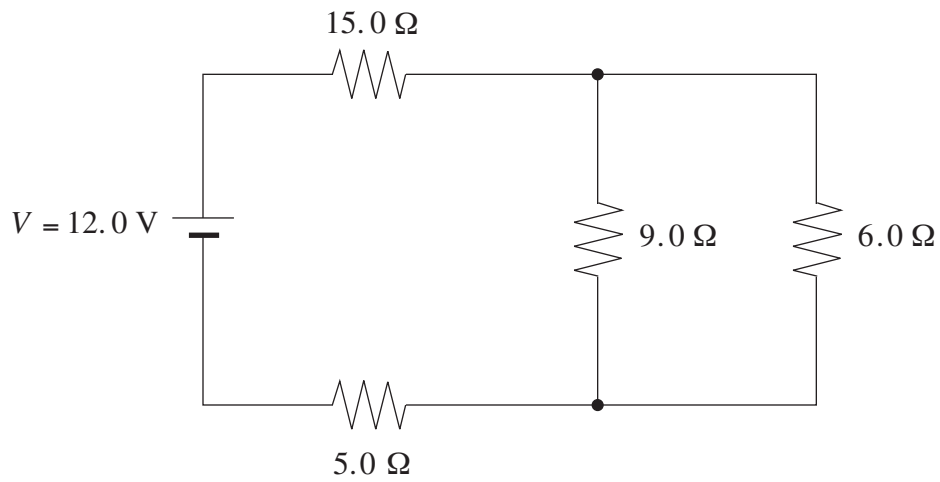
- a) Find the magnitude of the acceleration of the helium nucleus due to these plates. **(5 marks)**

ANSWER:

a) acceleration: _____

- b) A proton travelling at the same velocity as the helium nucleus is then sent through these same plates. Explain, using principles of physics, why the acceleration of the proton is larger than that of the helium nucleus. **(4 marks)**

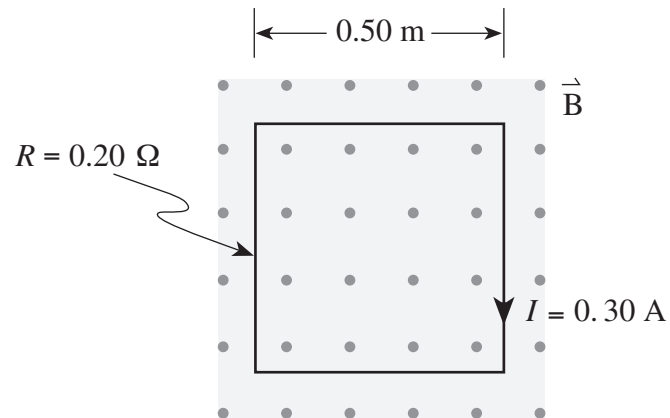
6. How much energy does the $6.0\ \Omega$ resistor dissipate in 15 seconds in the circuit shown? **(7 marks)**



ANSWER:
energy: _____

OVER

7. The single square loop of copper wire with a resistance of 0.20Ω has a current of 0.30 A due to a continuously increasing magnetic field.



At what rate, in T/s , is the magnetic field increasing?

(7 marks)

ANSWER:

rate of increase in magnetic field strength:

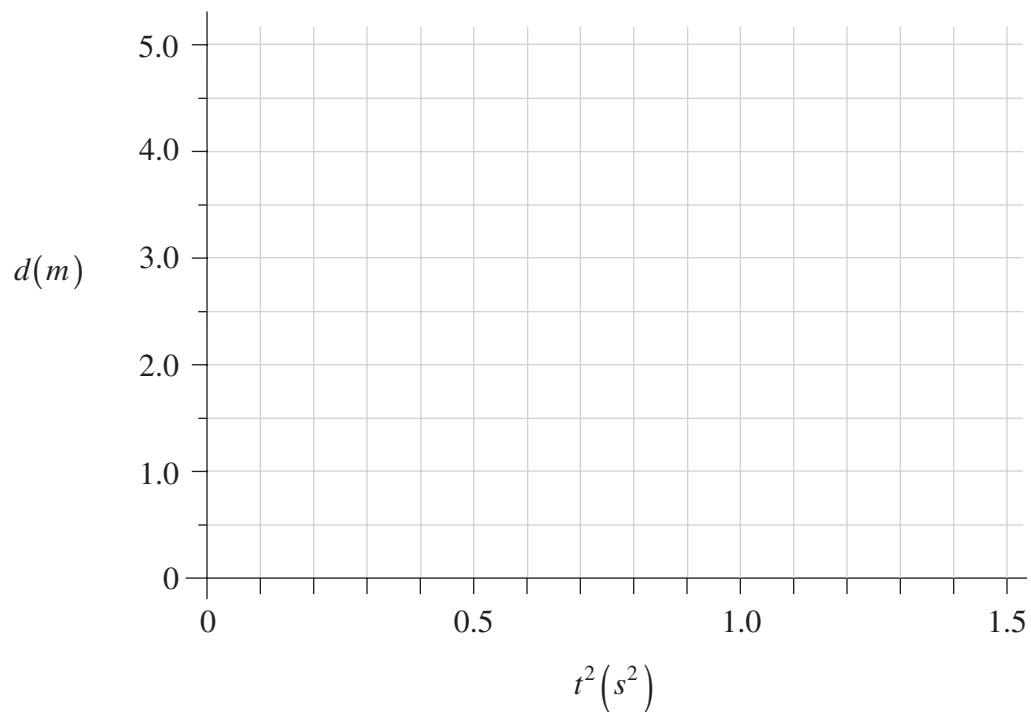
OVER

8. The first colonists on Mars conduct a physics experiment by dropping a small mass (from rest) and recording its displacement at regular time intervals. This data is shown below.

$d(m)$	$t(s)$	
0.30	0.40	
0.60	0.60	
1.20	0.80	
1.80	1.00	
2.70	1.20	

- a) Plot a graph of displacement versus time squared and draw the best fit straight line.

(2 marks)



b) Determine the slope of the line.

(2 marks)

ANSWER:

b) slope: _____

c) Based on this experiment, what is the acceleration due to gravity on Mars?

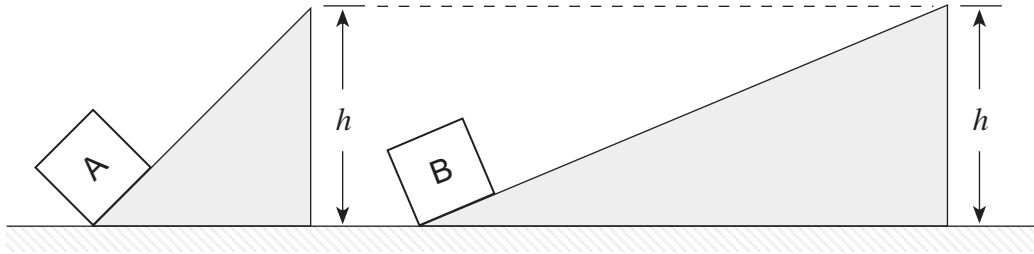
(1 mark)

ANSWER:

c) acceleration: _____

OVER

9. Identical blocks are placed on inclines as shown. The coefficients of friction between the blocks and the inclined surfaces are identical.



Both blocks are then pushed to the top of each incline at the same constant speed. Using principles of physics, explain which block required more work to reach the top of the incline.

(4 marks)

END OF EXAMINATION

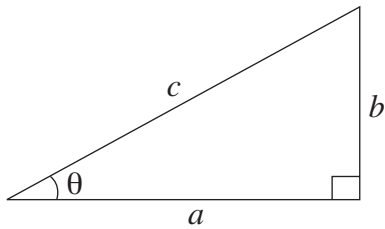
TABLE OF CONSTANTS

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	$\mu_o = 4\pi \times 10^{-7} \text{ T} \cdot \text{m/A}$
Speed of light	$c = 3.00 \times 10^8 \text{ m/s}$

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

MATHEMATICAL EQUATIONS

For Right-angled Triangles:

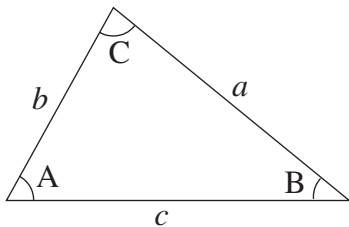


$$a^2 + b^2 = c^2$$

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

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

For All Triangles:



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

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

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

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

Circle:

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

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

Sphere:

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

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

Quadratic Equation:

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

Vector Kinematics in Two Dimensions:

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

$$v^2 = v_0^2 + 2ad \qquad d = v_0t + \frac{1}{2}at^2$$

Vector Dynamics:

$$F_{\text{net}} = ma \qquad F_g = mg$$

$$F_{\text{fr}} = \mu F_N$$

Work, Energy, and Power:

$$W = Fd \qquad E_p = mgh$$

$$E_k = \frac{1}{2}mv^2 \qquad P = \frac{W}{t}$$

Momentum:

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

Equilibrium:

$$\tau = Fd$$

Circular Motion:

$$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$$

Gravitation:

$$F = G \frac{m_1 m_2}{r^2} \qquad E_p = -G \frac{m_1 m_2}{r}$$

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Electrostatics:

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

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

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

Electric Circuits:

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

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

Electromagnetism:

$$F = BIl \quad F = QvB$$

$$B = \mu_0 n I = \mu_0 \frac{N}{l} I \quad \mathcal{E} = Blv$$

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

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

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

ROUGH WORK FOR MULTIPLE-CHOICE

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