

Insert Personal Education Number (PEN) here.

Insert **only** pre-printed PEN label here.

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.

PHYSICS 12

JUNE 2000

COURSE CODE = PH

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

Ministry use only.



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COLUMBIA**
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Question 1:

1. .

(7)

Question 9:

9. .

(4)

Question 2:

2. .

(7)

Question 3:

3. .

(7)

Question 4:

4. .

(9)

Question 5:

5. .

(7)

Question 6:

6. .

(7)

Question 7:

7. .

(7)

Question 8:

8. .

(5)

PHYSICS 12

JUNE 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.*

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PART A: MULTIPLE CHOICE

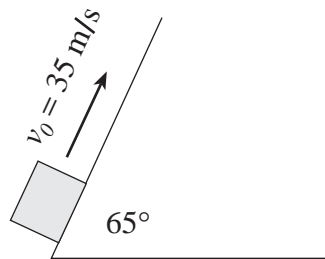
Value: 60 marks (2 marks per question)

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.

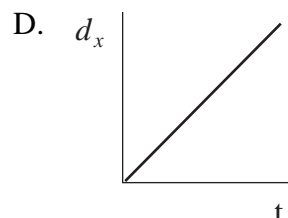
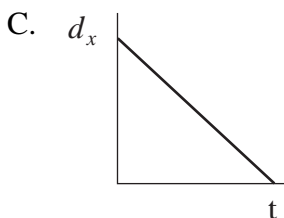
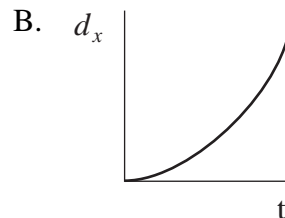
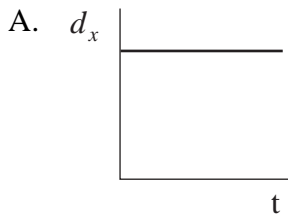
1. Which of the following contains scalar quantities only?
 - A. speed, energy
 - B. velocity, energy
 - C. speed, displacement
 - D. velocity, momentum

2. An object is fired up a frictionless ramp as shown in the diagram.



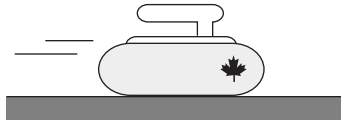
If the initial velocity is 35 m/s, how long does the object take to return to the starting point?

- A. 3.6 s
 - B. 3.9 s
 - C. 7.9 s
 - D. 17 s
-
3. Which of the following graphs best illustrates the horizontal displacement of a projectile as a function of time? Ignore friction.

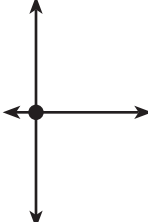





4. A constant net force acting on an object results in the object having a constant
- A. velocity.
 - B. momentum.
 - C. acceleration.
 - D. kinetic energy.

5. A curling rock is travelling to the right across the ice as shown in the diagram.



Which of the following best represents the forces acting on the curling rock?

- A.  B.  C.  D. 

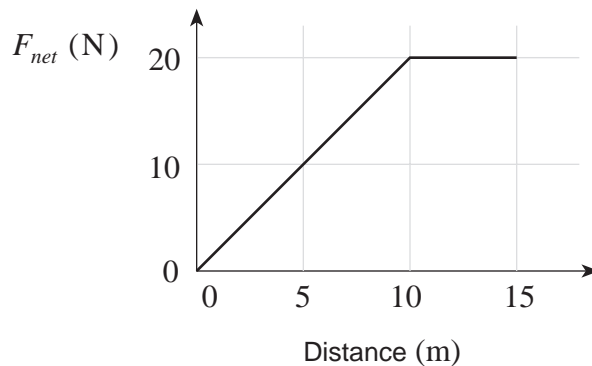
6. A change in kinetic energy is equivalent to

- A. work.
- B. power.
- C. impulse.
- D. momentum.

7. A 16 kg object is dropped from a height of 25 m and strikes the ground with a speed of 18 m/s. How much heat energy was produced during the fall?

- A. 0 J
- B. 1 300 J
- C. 2 600 J
- D. 3 900 J

8. A force is applied to an 8.0 kg object initially at rest. The magnitude of the net force varies with distance as shown.

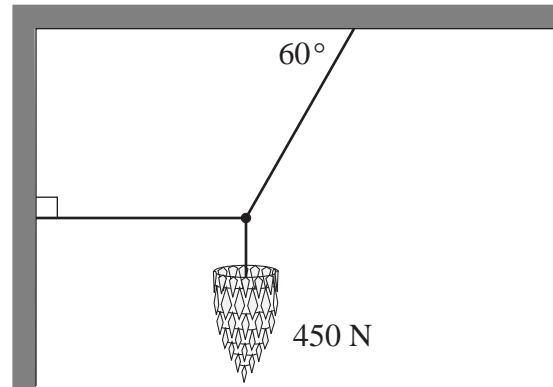


What is the speed of the object after moving 15 m?

- A. 5.0 m/s
 - B. 6.1 m/s
 - C. 7.1 m/s
 - D. 8.7 m/s
9. A machine rated at 1 500 W lifts a 100 kg object 36 m vertically in 45 s. What is the efficiency of this machine?
- A. 0.053
 - B. 0.48
 - C. 0.52
 - D. 0.65
10. Two cars collide head-on and come to a complete stop immediately after the collision. Which of the following is correct?

| | TOTAL MOMENTUM | TOTAL ENERGY |
|----|-----------------------|---------------------|
| A. | is conserved | is conserved |
| B. | is conserved | is not conserved |
| C. | is not conserved | is conserved |
| D. | is not conserved | is not conserved |

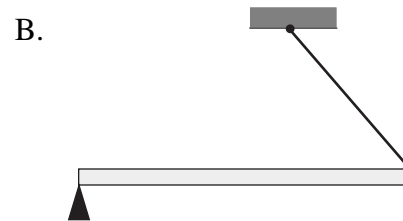
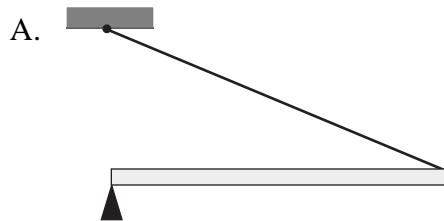
11. A 450 N chandelier is supported by three cables as shown in the diagram.



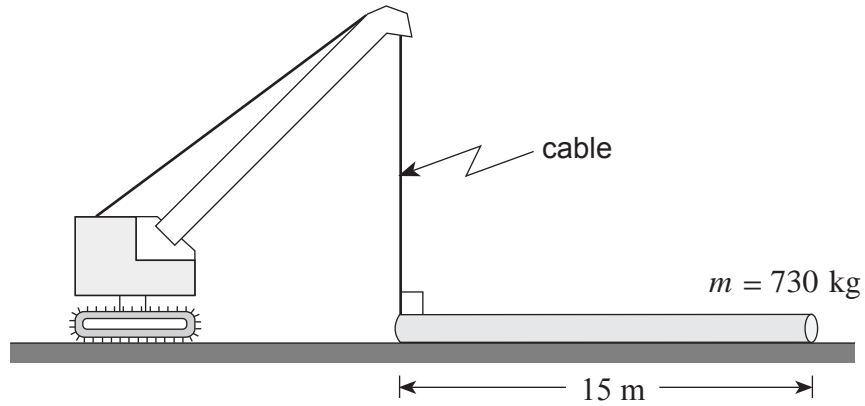
What is the tension in the horizontal cable?

- A. 46 N
- B. 260 N
- C. 450 N
- D. 520 N

12. A beam is to be kept horizontal by a cord. In which of the four situations shown below will the tension in the cord be least?

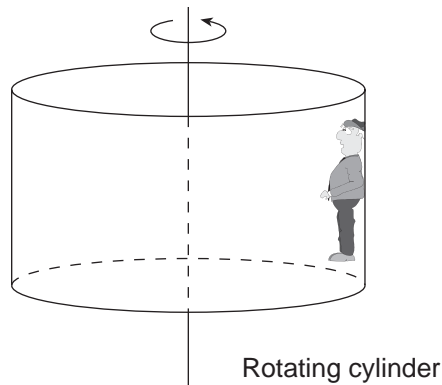


13. A crane is used to lift one end of a uniform 15 m long pipe with a mass of 730 kg as shown in the diagram below.



What is the minimum force of tension in the crane cable to just lift the end of the pipe off the ground?

- A. 3.7×10^2 N
 - B. 4.8×10^2 N
 - C. 3.6×10^3 N
 - D. 7.2×10^3 N
14. In a popular amusement park ride, a large cylinder is set in rotation. The floor then drops away leaving the riders suspended against the wall in a vertical position as shown.



Which of the following is the correct free-body diagram for the person at the position shown?

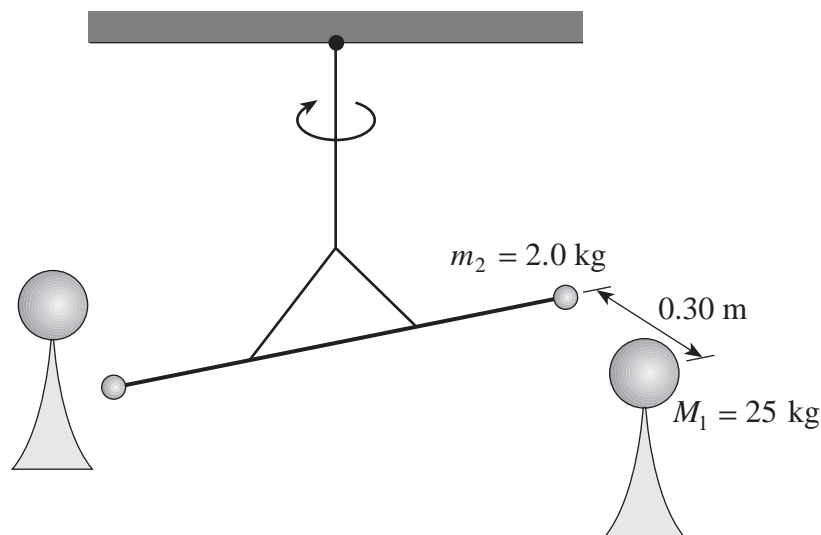
- A.
- B.
- C.
- D.

15. A 0.500 kg ball is swung in a horizontal circle of radius 1.20 m with a period of 1.25 s. What is the centripetal force on the ball?
- A. 0.384 N
 B. 15.2 N
 C. 18.9 N
 D. 30.3 N

16. A rock drops from a very high altitude towards the surface of the moon. Which of the following is correct about the changes that occur in the rock's mass and weight?

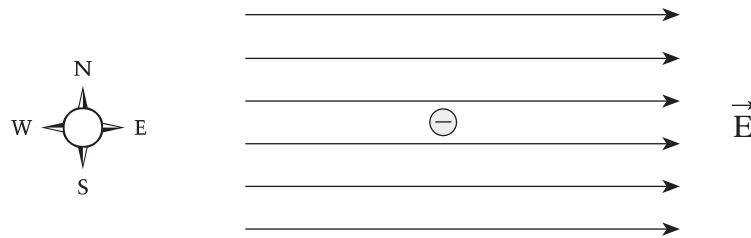
| | MASS | WEIGHT |
|----|------------------|-----------|
| A. | decreases | decreases |
| B. | decreases | increases |
| C. | remains constant | decreases |
| D. | remains constant | increases |

17. Cavendish's historic experiment is set up as shown to determine the force between two identical sets of masses. What would be the net force of attraction between **one** set of masses?



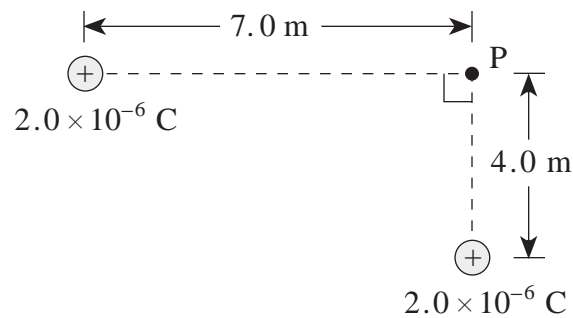
- A. 1.1×10^{-8} N
 B. 1.9×10^{-8} N
 C. 2.2×10^{-8} N
 D. 3.7×10^{-8} N

18. An electron in the electric field has an electric force acting on it in what direction?



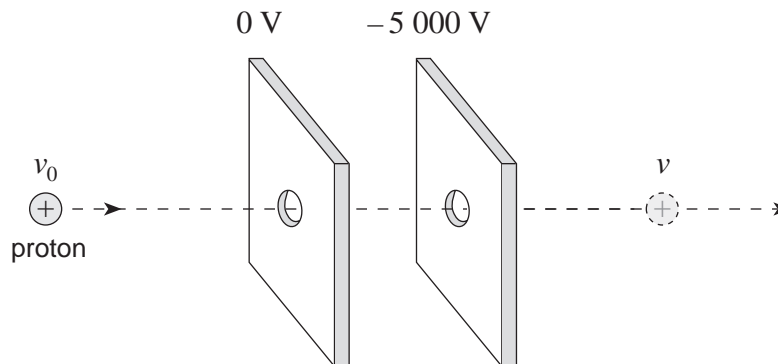
- A. North
- B. South
- C. East
- D. West

19. What is the electric potential at point P due to the two fixed charges as shown?



- A. 1 200 V
- B. 1 500 V
- C. 5 200 V
- D. 7 100 V

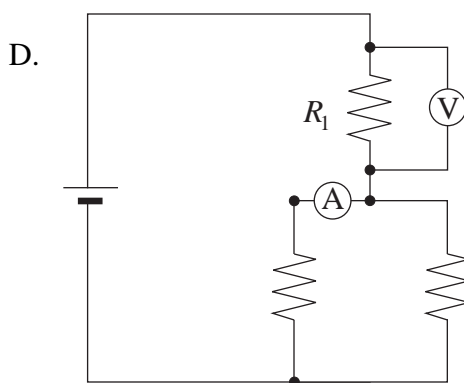
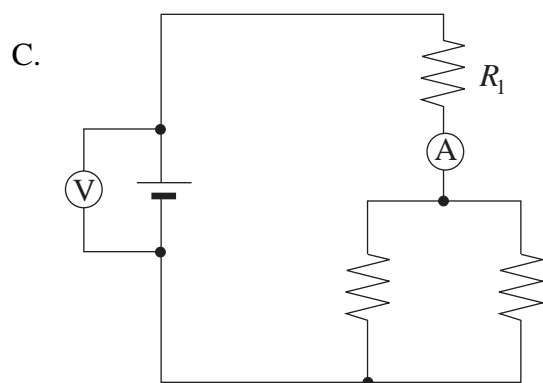
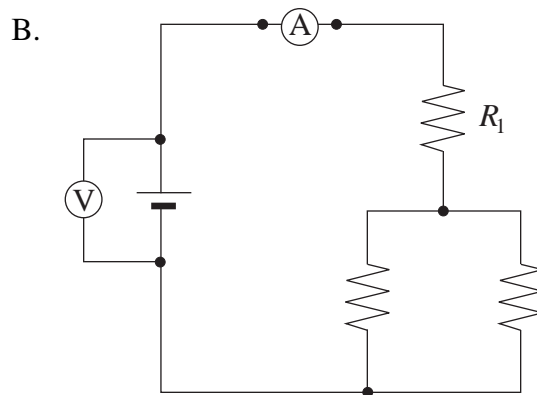
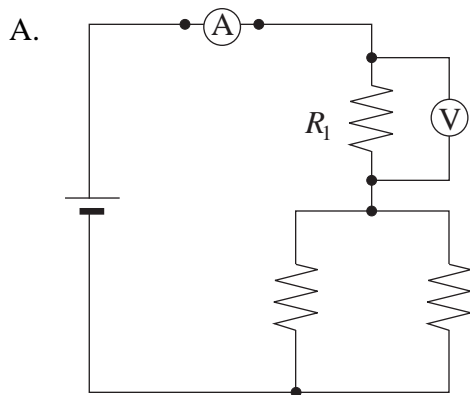
20. A moving proton has 6.4×10^{-16} J of kinetic energy. The proton is accelerated by a potential difference of 5 000 V between parallel plates.



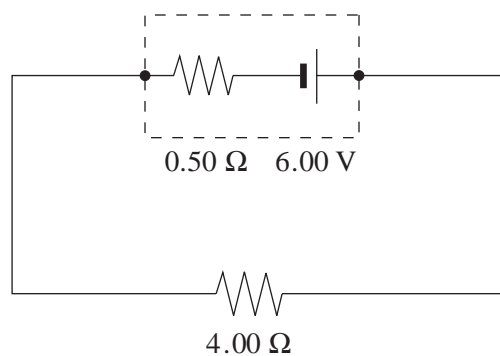
The proton emerges from the parallel plates with what speed?

- A. 8.8×10^5 m/s
- B. 9.8×10^5 m/s
- C. 1.3×10^6 m/s
- D. 1.8×10^6 m/s

21. Which one of the following shows the correct placement of an ammeter and a voltmeter to determine the power output of resistor R_1 ?

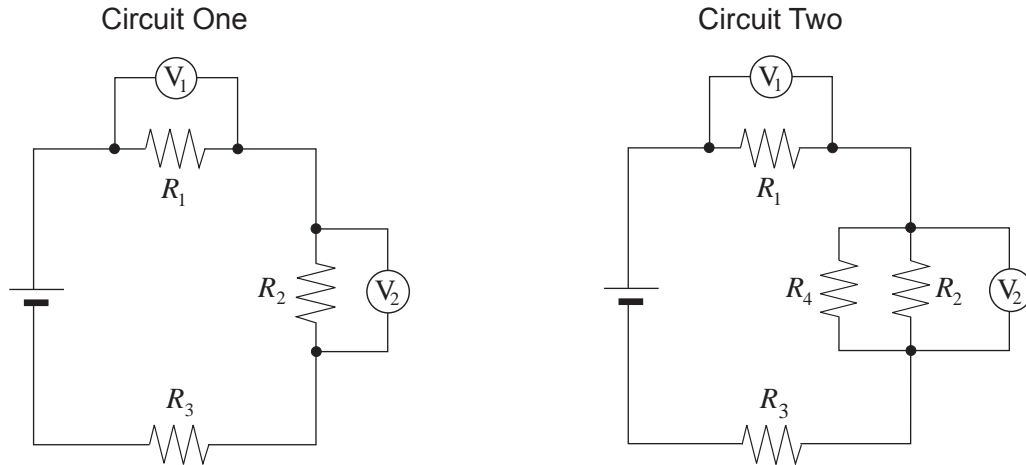


22. What is the terminal voltage of the battery in the circuit shown below?



- A. 5.25 V
- B. 5.33 V
- C. 6.00 V
- D. 6.67 V

23. In circuit one, resistors and voltmeters are connected as shown. In circuit two, an additional resistor R_4 is placed in parallel with resistor R_2 .



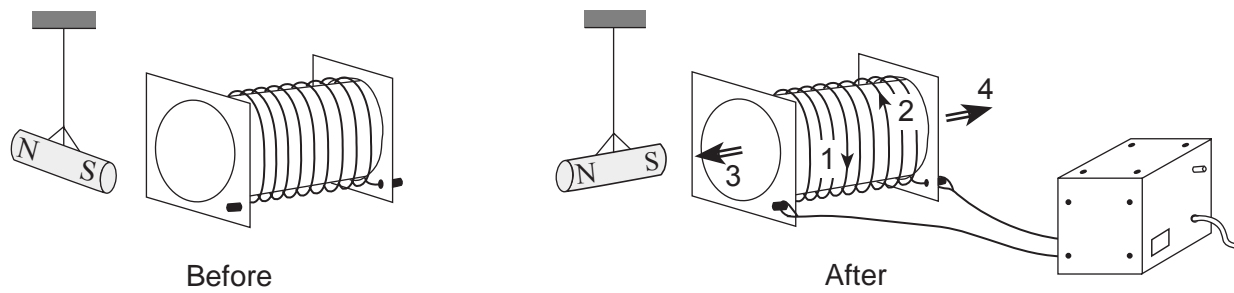
How have the values of V_1 and V_2 in circuit two changed compared to those in circuit one?

| | V_1 | V_2 |
|----|-----------|-----------|
| A. | no change | decreased |
| B. | decreased | increased |
| C. | increased | decreased |
| D. | increased | no change |

24. What are the units of magnetic flux?

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

25. The diagram shows a magnet suspended near a solenoid. After the solenoid has been connected to a power supply, the magnet rotates to a new position with its south pole pointing towards the solenoid.



Which arrows show the direction of the current in the solenoid and the direction of the magnetic field caused by this current?

| | DIRECTION OF CURRENT | DIRECTION OF MAGNETIC FIELD |
|----|----------------------|-----------------------------|
| A. | 1 | 3 |
| B. | 1 | 4 |
| C. | 2 | 3 |
| D. | 2 | 4 |

26. The diagram shows a conductor between a pair of magnets. The current in the conductor flows out of the page.



In what direction will the magnetic force act on the conductor?

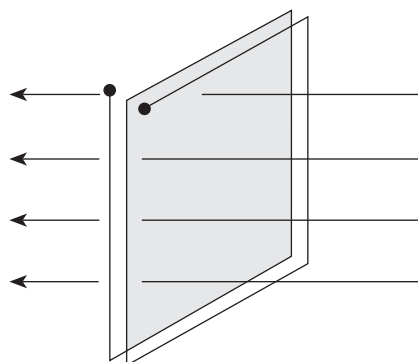
- A. up the page
- B. down the page
- C. towards the left
- D. towards the right

27. A charged particle travels in a circular path in a magnetic field. What changes to the magnetic field and to the velocity of the particle would both cause the radius of its path to decrease?

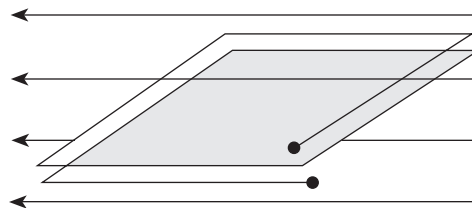
| | CHANGE TO THE MAGNETIC FIELD | CHANGE TO THE VELOCITY |
|----|------------------------------|------------------------|
| A. | increase | increase |
| B. | increase | decrease |
| C. | decrease | increase |
| D. | decrease | decrease |

28. The diagram below shows two coils in a magnetic field.

Coils perpendicular to magnetic field



Coils parallel to magnetic field

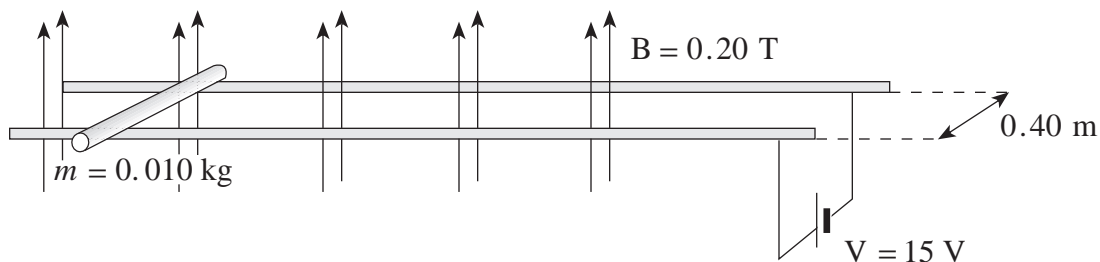


An electric current can be induced in the coil oriented with its plane

- A. parallel to a constant magnetic field.
 B. parallel to a changing magnetic field.
 C. perpendicular to a constant magnetic field.
 D. perpendicular to a changing magnetic field.
29. An electric motor is connected to a 12.0 V power supply. When the armature is prevented from rotating, the current is 8.0 A. When the motor is running at normal speed, the current is 2.0 A. What is the back emf in each case?

| | BACK EMF WHEN STATIONARY | BACK EMF WHEN RUNNING |
|----|--------------------------|-----------------------|
| A. | 0 V | 9.0 V |
| B. | 0 V | 3.0 V |
| C. | 12 V | 9.0 V |
| D. | 12 V | 3.0 V |

30. The diagram shows a 0.010 kg metal rod resting on two long horizontal frictionless rails which remain 0.40 m apart. The circuit has a resistance of 3.0Ω and is located in a uniform 0.20 T magnetic field.



Find the initial acceleration and maximum velocity for the rod.

| | INITIAL ACCELERATION | MAXIMUM VELOCITY |
|----|----------------------|-------------------|
| A. | 40 m/s^2 | 190 m/s |
| B. | 40 m/s^2 | 300 m/s |
| C. | 120 m/s^2 | 190 m/s |
| D. | 120 m/s^2 | 300 m/s |

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

PART B: WRITTEN RESPONSE

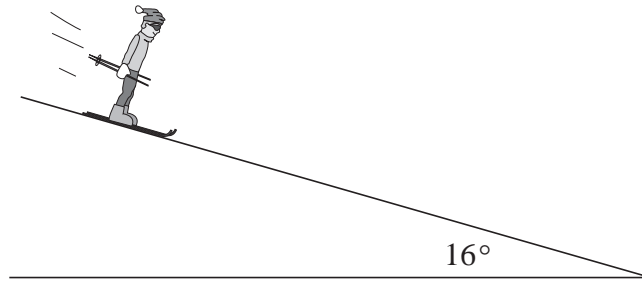
Value: 60 marks

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. A 75 kg Olympic skier takes 20 s to reach a speed of 25 m/s from rest while descending a uniform 16° slope.



What is the coefficient of friction between the skis and the slope surface?

(7 marks)

ANSWER:

coefficient of friction: _____

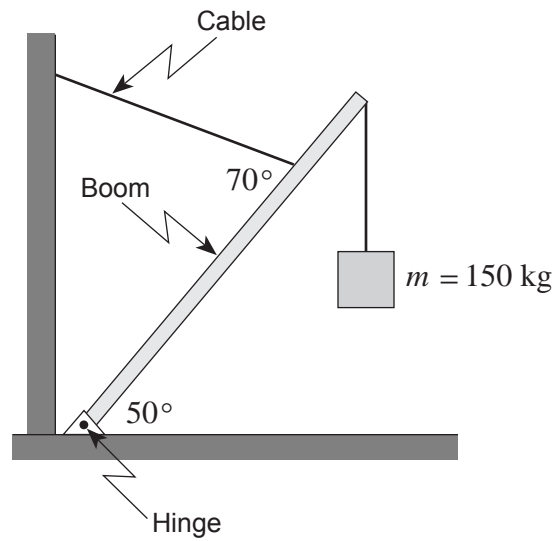
ANSWER:

speed: _____

direction (angle θ): _____

OVER

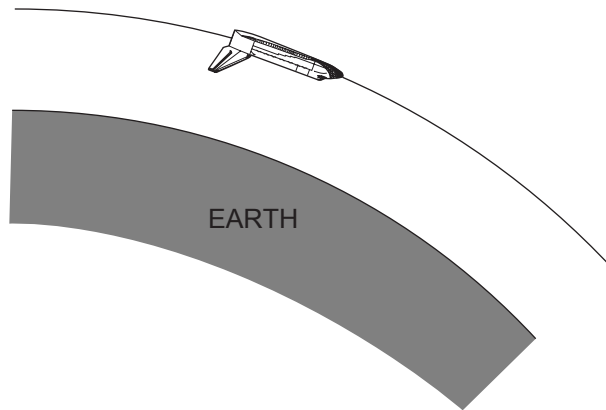
3. A uniform 6.0 m-long boom has a mass of 55 kg. It is kept in position by a restraining cable attached three-quarters of the way along the boom.



What is the tension in this cable when the boom supports a 150 kg mass as shown? **(7 marks)**

ANSWER:
tension: _____

4. A space shuttle is placed in a circular orbit at an altitude of 3.00×10^5 m **above** Earth's surface.



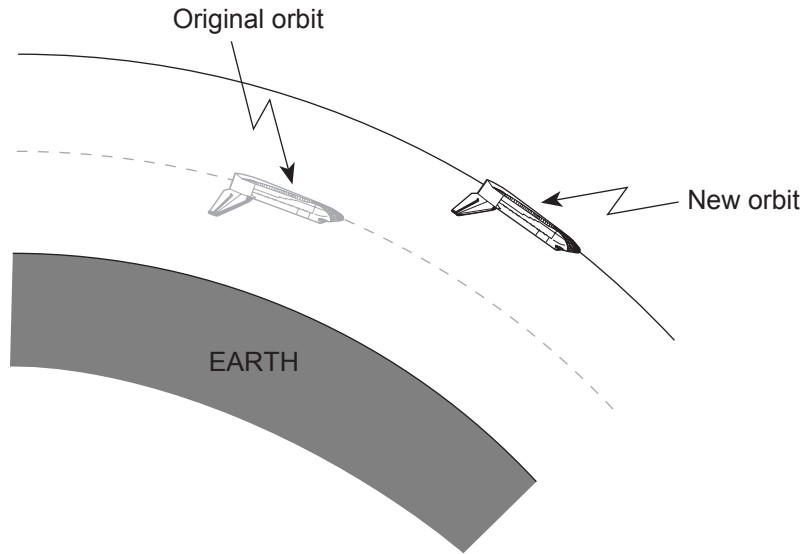
- a) What is the shuttle's orbital speed?

(5 marks)

ANSWER:

a) orbital speed: _____

b) The space shuttle is then moved to a higher orbit in order to capture a satellite.



The shuttle's speed in this new higher orbit will have to be

- greater than in the lower orbit.
- less than in the lower orbit.
- the same as in the lower orbit.

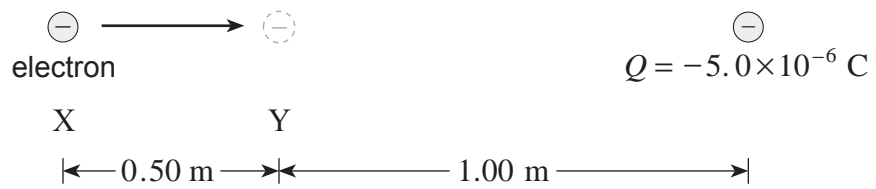
(Check one response.)

(1 mark)

c) Using principles of physics, explain your answer to b).

(3 marks)

5. a) How much work is done in moving an electron from point X to point Y? **(5 marks)**



ANSWER:

a) work: _____

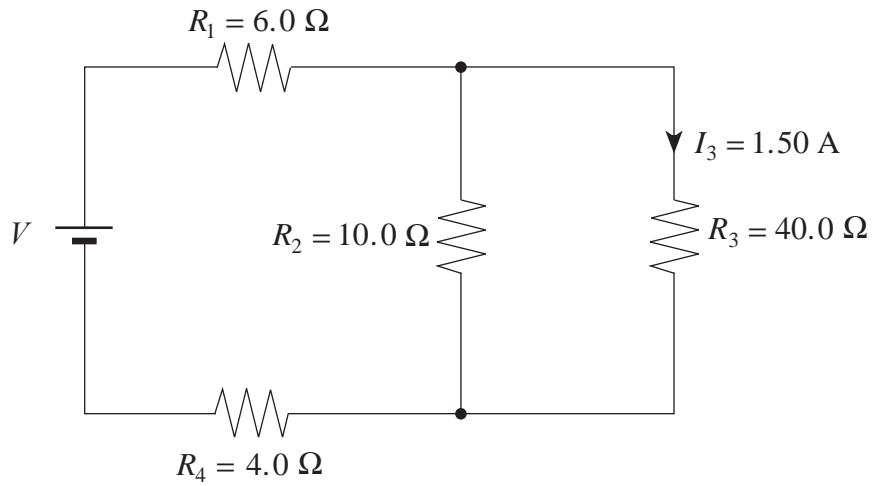
b) What is the potential difference between point X and point Y?

(2 marks)

ANSWER:

b) potential difference: _____

6. A current of 1.50 A flows through the 40.0 Ω resistor.



What is the potential difference of the power supply?

(7 marks)

ANSWER:

potential difference: _____

7. A transformer has 840 primary and 56 secondary windings. The primary coil is connected to a 110 V ac power supply which delivers a 0.30 A current to the transformer.
- a) Find the secondary voltage. **(4 marks)**

ANSWER:

a) secondary voltage: _____

b) Find the secondary current.

(3 marks)

ANSWER:

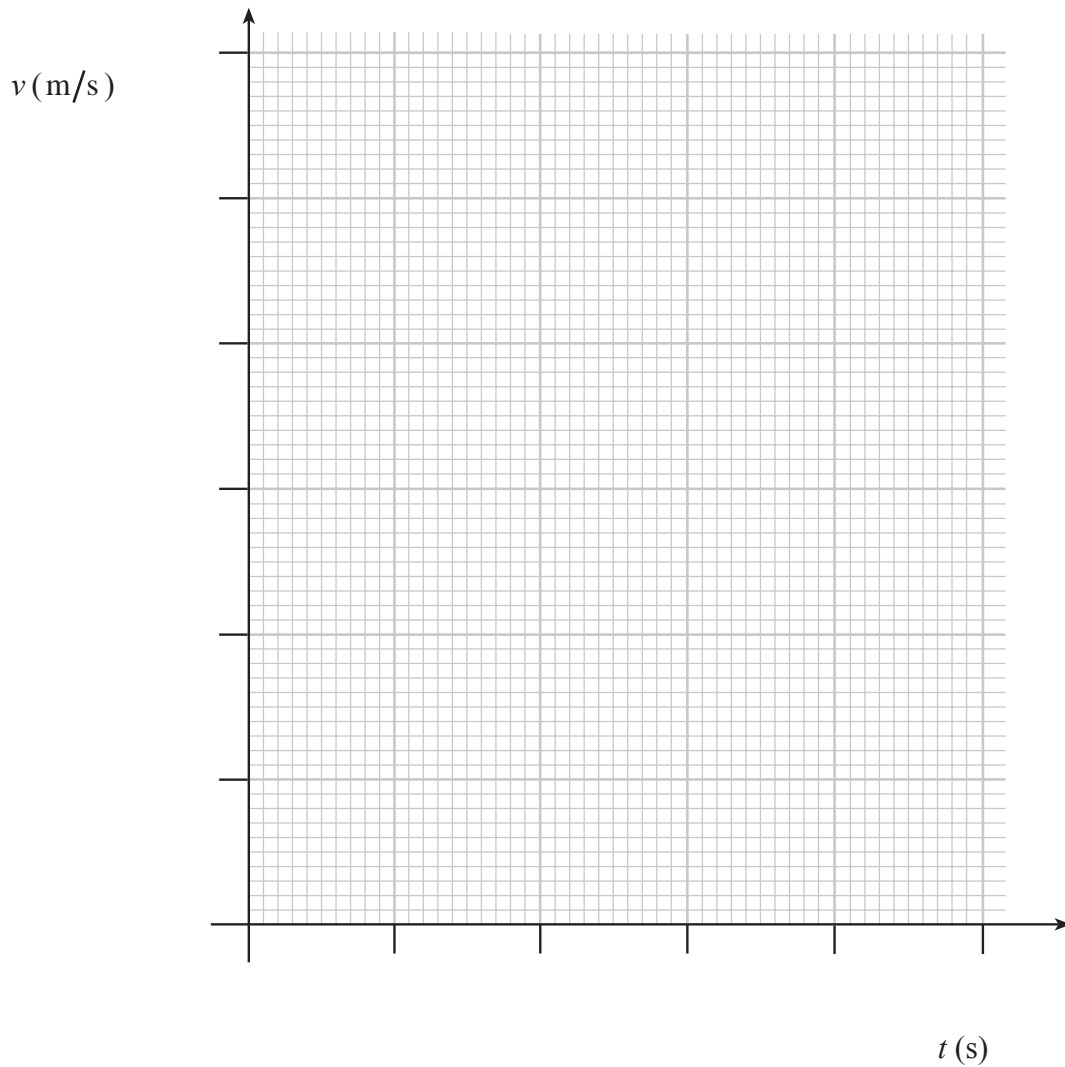
b) secondary current: _____

8. The data table shows the velocity of a car during a 5.0 s interval.

| | | | | | | |
|-----------|-----|-----|-----|-----|-----|-----|
| t (s) | 0.0 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 |
| v (m/s) | 12 | 15 | 15 | 18 | 20 | 21 |

a) Plot the data and draw a best-fit straight line.

(2 marks)



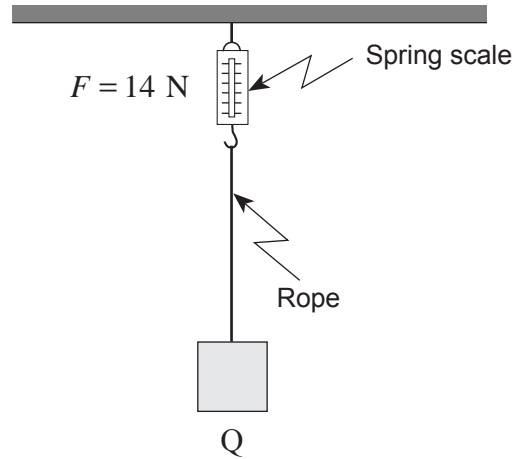
b) Calculate the area bounded by the graph and the time axis between $t = 0.0$ s and $t = 5.0$ s. **(2 marks)**

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

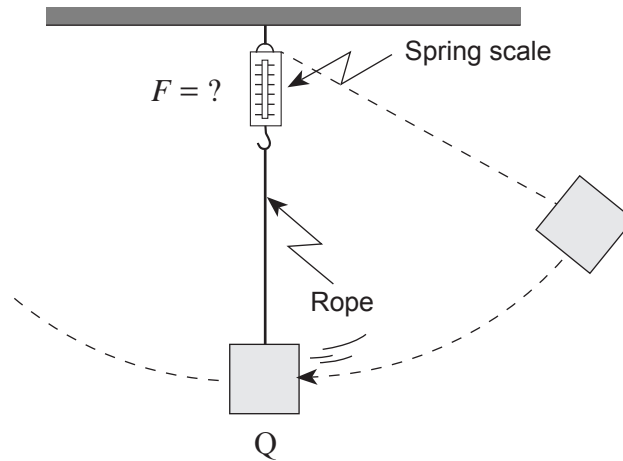
ANSWER:

b) area: _____

9. A mass is suspended by a string attached to a spring scale that initially reads 14 N as shown in Diagram 1.



The mass is pulled to the side and then released as shown in Diagram 2.



As the mass passes point Q, how will the reading on the spring scale compare to the previous value of 14 N? Using principles of physics, explain your answer. **(4 marks)**

END OF EXAMINATION

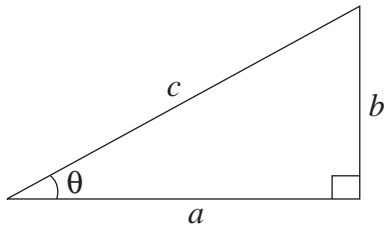
TABLE OF CONSTANTS

| | |
|---|---|
| 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:

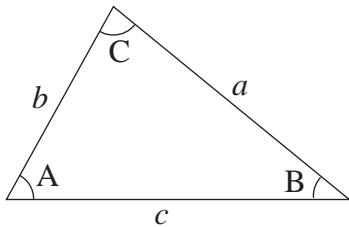


$$a^2 + b^2 = c^2$$

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

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

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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Exercise care when tearing along perforations.**

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:

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

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

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

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

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

ROUGH WORK FOR MULTIPLE-CHOICE

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ROUGH WORK FOR MULTIPLE-CHOICE