NOVA SCOTIA
Department of Education

ATLANTIC CANADA EXAMINATIONS

PHYSICS 12

JUNE 2001

Comment Box—For Use by Teacher

What accommodations have been made?

By whom?

Position/Title:

Why?

Name:_____

General Instructions

This examination is composed of three sections, with an estimated time allotment as listed below:

Selected Response Questions, value 40, 40 minutes total
Constructed Response Questions, value 50, 100 minutes total
Case Study, value 10, 20 minutes total

Include an additional 20 minutes for organization and extra writing time.

Total time: 3 hours

Use these estimates to guide you in the completion of the examination. It is not necessary to spend the estimated time on each section. Plan your time so as to enable you to complete the examination.

Calculators are permitted, but are not to be shared.

Selected Response Questions
(Total Value: 40)

In this part of the examination, there are 40 multiple choice questions, each with a value of one. Read each question carefully and decide which of the choices best answers the question asked. You are provided with a separate answer form. Fill in the space that corresponds to your choice. Use HB pencil only.

Fill in the answers to the multiple choice questions in this part of the examination in 1 to 40 of section 1 on side 1 of the response form supplied by the test administrator. At the completion of the examination, place the response form in the examination booklet.

Example

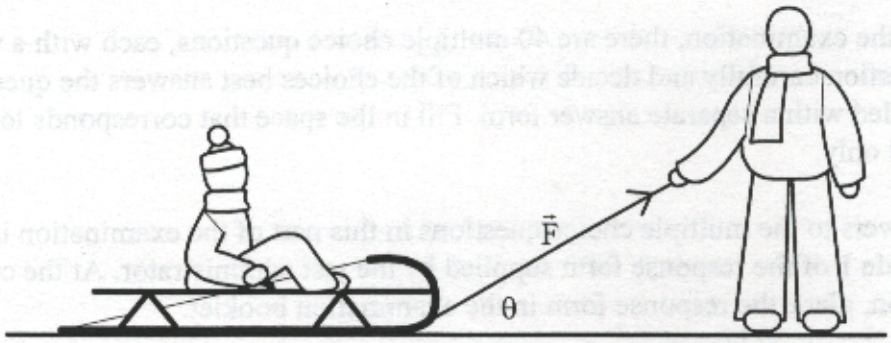
Which unit is an SI unit of distance?
A. feet
B. inches
C. metres
D. cubits

Answer Sheet
A B C D
○ ○ ● ○

If you wish to change an answer, erase your first mark completely.

Do not turn the page to start the examination until told to do so by the presiding examiner.

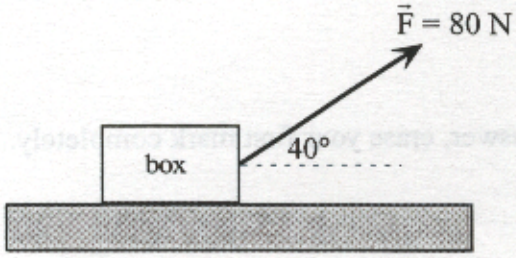
1. In the diagram below, a force $\vec{F}$ is applied to the rope connected to a toboggan. The rope makes an angle (θ) to the ground.



The magnitude of the horizontal component of the force depends on which of the following?

A. the magnitude of the angle only
B. the magnitude of the force only
C. the magnitudes of both the angle and the force
D. neither the angle nor the force

2. A force of 80 N is applied to a box by pulling on a rope at an angle of 40° with a horizontal table as shown in the following diagram.



What is the horizontal component of the force?

A. 32 N
B. 51 N
C. 61 N
D. 67 N

3. The driver of a motor boat points it directly toward the opposite bank of a 52 m wide river. The speed of the boat is 4.0 m/s and the river flows at 3.2 m/s. When the boat reaches the opposite riverbank, what is the distance from its point of departure?

A. 10 m
B. 42 m
C. 52 m
D. 65 m

4. An object was subjected to several forces: 50 N from the east, 40 N from the south, 85 N from the west, and 55 N from the north. What is the magnitude of the resultant force?

A. 15 N
B. 25 N
C. 38 N
D. 42 N

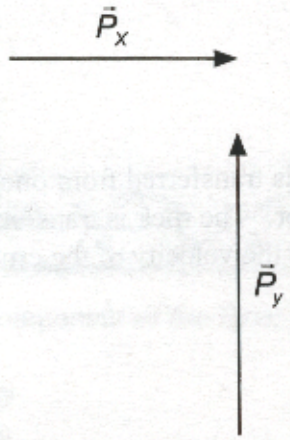
5. In a concrete mixing plant, crushed rock is transferred from one floor to another by a conveyor belt that has an angle of 30° with the floor. The rock is transferred a vertical distance of 5.0 m in a time of 23 s. Which of the following is the velocity of the crushed rock on the conveyor belt?

A. 0.22 m/s
B. 0.25 m/s
C. 0.38 m/s
D. 0.43 m/s

6. A 3.00 m long window cleaning scaffold of uniform construction has a mass of 120.0 kg. A 60.0 kg person is standing 1.20 m from the left-hand end. What upward force must be provided by the rope at the right-hand end?

A. 185 N
B. 823 N
C. 900 N
D. 2480 N

7. The diagram below represents an inelastic collision between two objects. Object X has a mass of 2.00 kg and moves with a velocity of 3.00 m/s, East. Object Y has a mass of 1.75 kg and moves with a velocity of 5.00 m/s, North. The two objects collide as shown in the following diagram.



After the collision, what is the system's direction of motion?

A. 34.4° E of N
B. 34.4° W of N
C. 34.4° E of S
D. 34.4° W of S

8. In a collision between two objects that stick together and move together after impact, there can be conservation of which of the following?

A. momentum but not kinetic energy
B. kinetic energy but not momentum
C. both momentum and kinetic energy
D. neither momentum nor kinetic energy

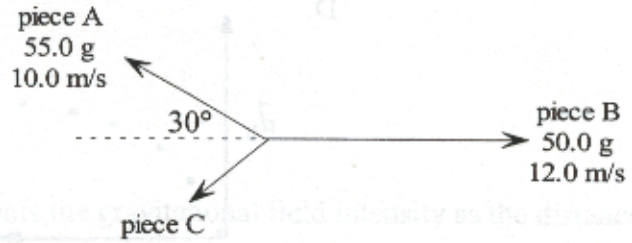
9. The initial momentum of an object is 10.0 kg• m/s, east, and its final momentum is 5.00 kg • m/s, south. What is its change in momentum?

A. 11.2 kg• m/s, 26.6° S of E
B. 11.2 kg• m/s, 26.6° S of W
C. 11.2 kg• m/s, 63.4° S of E
D. 11.2 kg• m/s, 63.4° S of W

10. A 4.00 kg mass moving at 10.0 m/s, south collides with a stationary 8.00 kg mass. The 4.00 kg mass comes to a stop and the 8.00 kg mass breaks into two equal pieces. One piece moves at 7.08 m/s, southeast. What is the velocity of the other piece?

A. 2.92 m/s, southeast
B. 2.92 m/s, southwest
C. 7.08 m/s, southeast
D. 7.08 m/s, southwest

11. A 125 g crystal glass is shattered into three pieces by the sound of an opera singer's voice. The pieces separate as shown.

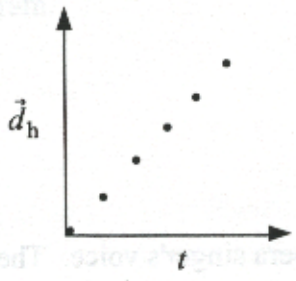


What is the momentum of the third piece?

A. 0.124 kg • m/s
B. 0.275 kg • m/s
C. 0.302 kg • m/s
D. 0.612 kg • m/s

12. An object has been projected horizontally off a table. Which graph represents the horizontal component of its velocity?

A.



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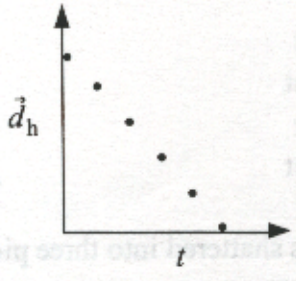
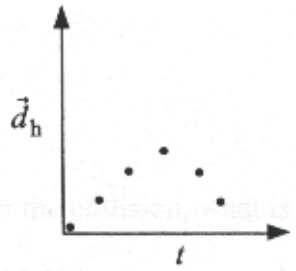
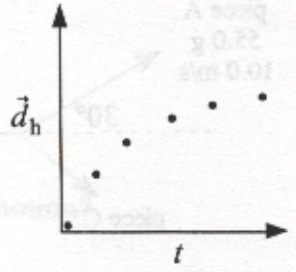


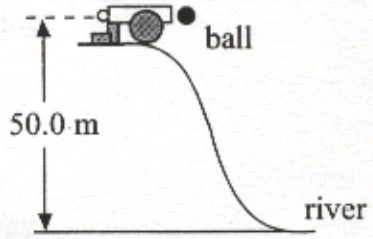
C.



D.



13. A cannon ball is shot horizontally at a velocity of 300 m/s from the top of a river bank 50.0 m above a river as shown in the following diagram. The cannon ball lands in the river.



How long does it take the cannon ball to reach the river below?

A. 0.167 s
B. 3.19 s
C. 5.10 s
D. 10.2 s

14. A student standing on top of a building throws a ball with a horizontal velocity of 12 m/s. If the ball strikes the ground 45 m from the base of the building, how high is the building?

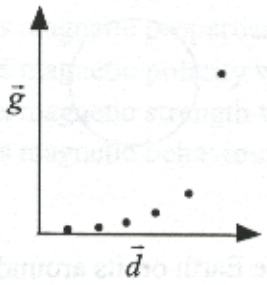
A. 18 m
B. 37 m
C. 69 m
D. 140 m

15. The mass of Jupiter is 1.90×10^{27} kg and its radius is 6.98×10^{7} m. What is the weight of a 50.0 kg instrument package on this planet?

A. 5.00×10^{1} N
B. 4.90×10^{2} N
C. 1.30×10^{3} N
D. 1.60×10^{5} N

16. Which diagram represents the gravitational field intensity as the distance from the centre of the Earth increases?

A.



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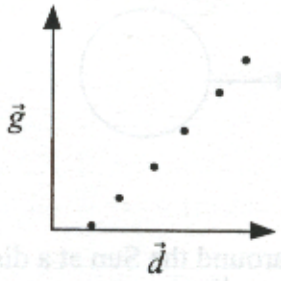

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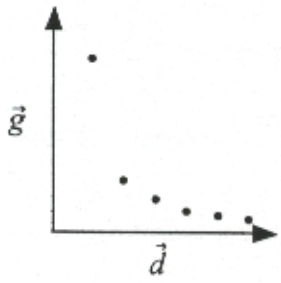
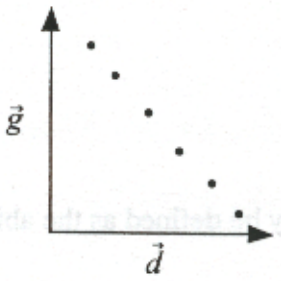


D.

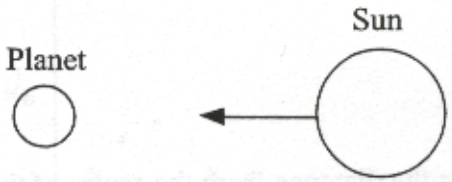


17. The force of gravity on the planet Deltagon acts on Object X and Object Y. Object X has one half the mass of Object Y and is one half as far from the centre of the planet as Object Y. What is the ratio of the force of gravity on Object X compared to the force of gravity on Object Y?

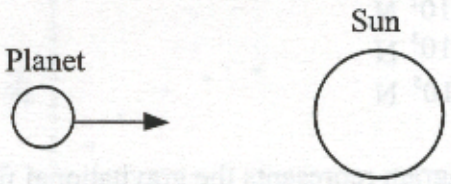
A. 1:1
B. 1:2
C. 2:1
D. 1:4

18. In applying Newton's universal law of gravitation to a planet and the Sun, which diagram illustrates the part of this law that relates to forces of attraction?

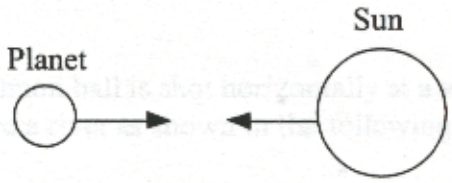
A.



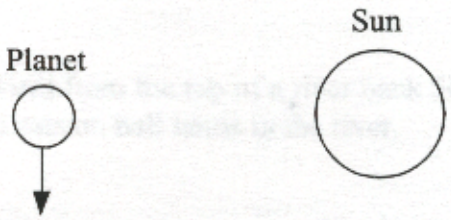
B.



C.



D.



19. An asteroid is orbiting around the Sun at a distance of 4.2×10^{11} m . If the Earth orbits around the Sun at a distance of 1.5×10^{11} m with a period of 3.2×10^{7} s, what is the period of the asteroid?

A. 1.1×10^{7} s
B. 6.4×10^{7} s
C. 9.0×10^{7} s
D. 1.5×10^{8} s

20. Magnetic induction may be defined as the ability of:

A. soft iron held near the north pole of a magnet to become temporarily magnetized
B. soft iron held near the north pole of a compass to become temporarily electrified
C. hard magnets held near the south pole of a magnet to become temporarily saturated
D. hard magnets held near the south pole of a compass to become temporarily permeated

21. The diagram below shows two long, straight, and parallel conductors with currents as shown. The current is flowing into the page for Conductor Y [shown with a (×)] and flowing out of the page for Conductor W [shown with a (•)].

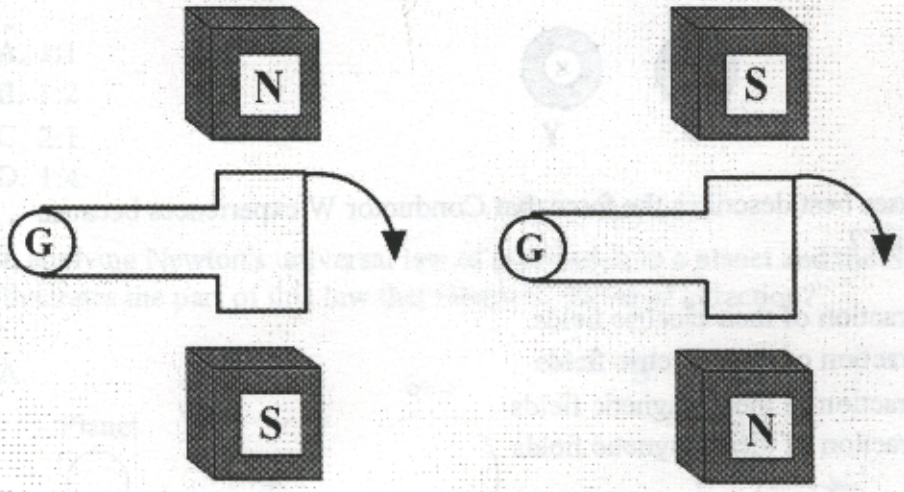
Which of the following phrases best describes the force that Conductor W experiences because of the presence of Conductor Y?

A. attraction due to the interaction of their electric fields
B. repulsion due to the interaction of their electric fields
C. attraction due to the interaction of their magnetic fields
D. repulsion due to the interaction of their magnetic fields

22. During an experiment with an electromagnet, a student disconnected the wires leading from the electromagnet to the battery. When she reconnected these wires, the student reversed the terminal connections. What will happen to the electromagnet?

A. Its magnetic properties will be lost.
B. Its magnetic polarity will be reversed.
C. Its magnetic strength will be decreased.
D. Its magnetic behaviour will not be changed.

23. Each diagram below shows the same conducting loop rotating in a magnetic field of the same strength.



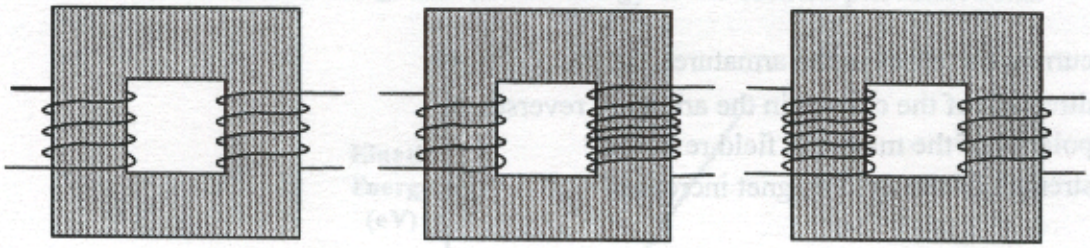
Is there a difference between the value of the maximum EMF induced by the same rate of rotation of the loop in each diagram?

A. Yes, the EMF will increase and it will have opposite polarity.
B. Yes, the EMF will increase and it will have the same polarity.
C. No, the EMF will be constant but it will have opposite polarity.
D. No, the EMF will be constant but it will have the same polarity.

24. Which statement best represents a definition of Lenz's law?

A. A conductor in a magnetic field experiences a force perpendicular to itself and the field.
B. The magnetic field of an induced current opposes the change in magnetic field causing it.
C. A current can be induced only when the magnetic field surrounding a conductor is changing.
D. The potential difference across a conductor is directly proportional to the current through it.

25. Each diagram below represents a transformer.



(1) (2) (3)

Which diagrams represent either a step-up or a step-down transformer?

A. 1 and 2 only
B. 1 and 3 only
C. 2 and 3 only
D. 1, 2, and 3

26. Which of the following will NOT increase the amount of electrical energy produced by a generator?

A. Increasing the number of windings on the armature.
B. Increasing the speed of rotation.
C. Increasing the temperature in the windings.
D. Winding the armature on a soft iron core.

27. Which of the following is the best description of the current leaving a DC generator?

A. It maintains a constant value.
B. It varies in direction.
C. It increases and decreases once in each revolution of the armature.
D. It increases and decreases twice in each revolution of the armature.

28. The hand rule for motors uses the thumb, the index finger, and the second finger to represent various properties. What does the thumb represent?

A. The direction of the applied force.
B. The direction of the current.
C. The direction of the magnetic field.
D. The direction of the magnetic force.

29. A direct current source is used to operate an electric motor. Which of the following statements best explains what happens at each half rotation of the split ring commutator?

A. The current increases in the armature.
B. The direction of the current in the armature reverses.
C. The polarity of the magnetic field reverses.
D. The strength of the field magnet increases.

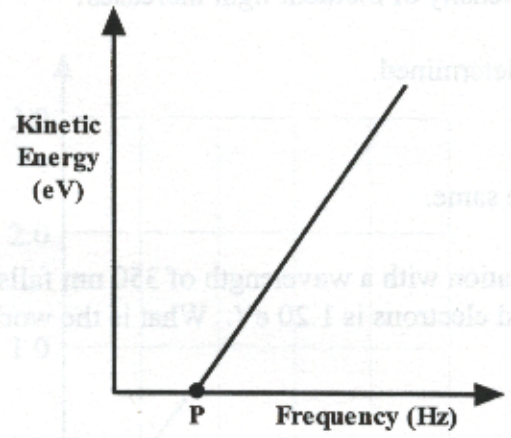
30. The knowledge that electromagnetic waves had energy led Maxwell to predict that they would also have the ability to do which of the following?

A. Expose a photographic plate.
B. Reflect off of the high ionosphere.
C. Exert pressure due to their momentum.
D. Display wave and particle characteristics.

31. A space probe moving at 2.00×10^{6} m/s toward the outer edges of the solar system sends back a radio transmission. At a control station on Earth, a physicist measuring the speed of the radio signal would obtain which of the following values?

A. 1.50×10^{8} m/s
B. 2.98×10^{8} m/s
C. 3.00×10^{8} m/s
D. 3.02×10^{8} m/s

32. The graph below shows the relationship between the frequency of radiation incident on a photosensitive surface and the maximum kinetic energy of the emitted photoelectrons.



What does point P represent?

A. Threshold frequency
B. Photoelectron frequency
C. Photon escape frequency
D. Work function frequency

33. The work function of a particular photoemissive material is 4.0 eV. If photons with 8.0 eV of energy are incident on the material, what would be the maximum kinetic energy of the ejected photoelectrons?

A. 2.0 eV
B. 4.0 eV
C. 8.0 eV
D. 12 eV

34. While experimenting with the photoelectric effect, students project a form of electromagnetic radiation at the cathode of a photocell, but no photoelectric current is observed in the circuit. Why are they are unable to observe this current?

A. The intensity of the radiation is too low.
B. The temperature of the cathode is too low.
C. The frequency of the radiation is too high.
D. The work function of the cathode is too high.

35. Electrons are emitted from a photoelectric surface only when the incident light is higher than a value called the threshold frequency. Above this frequency, what happens to the current of photoelectrons when the intensity of incident light increases?

A. The current cannot be determined.
B. The current decreases.
C. The current increases.
D. The current remains the same.

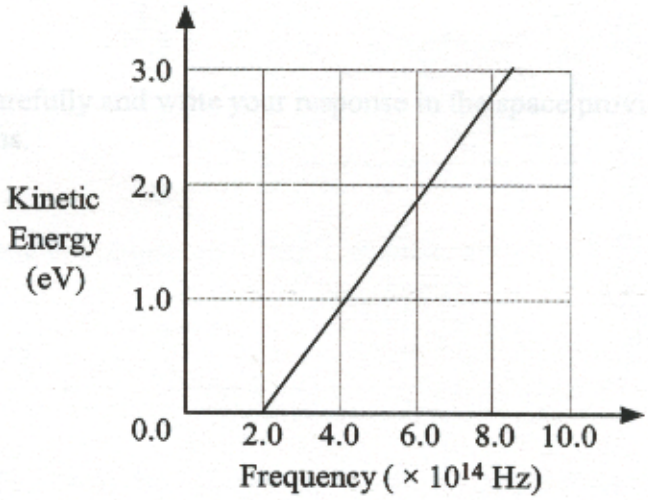
36. When electromagnetic radiation with a wavelength of 350 nm falls on a metal, the maximum kinetic energy of the ejected electrons is 1.20 eV. What is the work function of the metal?

A. 1.3 eV
B. 2.4 eV
C. 5.4 eV
D. 5.7 eV

37. While experimenting with the photoelectric effect, students increase the energy of a source of light to the threshold frequency. As the frequency continues to increase, which statement best explains how the kinetic energy of the emitted photoelectrons relates to the frequency?

A. The kinetic energy of the emitted photoelectrons is directly proportional to the frequency.
B. The kinetic energy of the emitted photoelectrons is inversely proportional to the frequency.
C. The kinetic energy of the emitted photoelectrons is directly proportional to the square of the frequency.
D. The kinetic energy of the emitted photoelectrons is inversely proportional to the square of the frequency.

38. Students did an experiment to find the value of Planck's constant. They plotted a graph showing the maximum kinetic energy of electrons ejected from a metal versus the frequency of the incident photons.



Based on the students' graph, what is the best estimate of Planck's constant?

A. 5.6×10^{-34} J• s
B. 6.0×10^{-34} J• s
C. 7.2×10^{-34} J• s
D. 7.6×10^{-34} J• s

39. In 1923, Louis-Victor deBroglie suggested which of the following?

A. An object's momentum and position cannot be determined at the same time.
B. Any mass can be totally converted to energy.
C. Luminous objects radiate light only at specific discrete frequencies.
D. Material particles have wave properties.

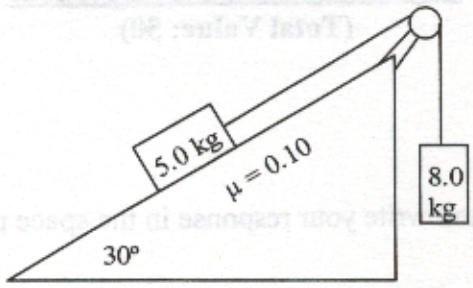
40. An atom of ${}^{234}_{92}U$ absorbs a neutron as shown in the equation, ${}^{234}_{92}U+{}^{1}_{0}n \rightarrow X$. What is the mass number and atomic number of element X, respectively?

A. 233 and 91
B. 233 and 92
C. 235 and 91
D. 235 and 92

Constructed Response Questions
(Total Value: 50)

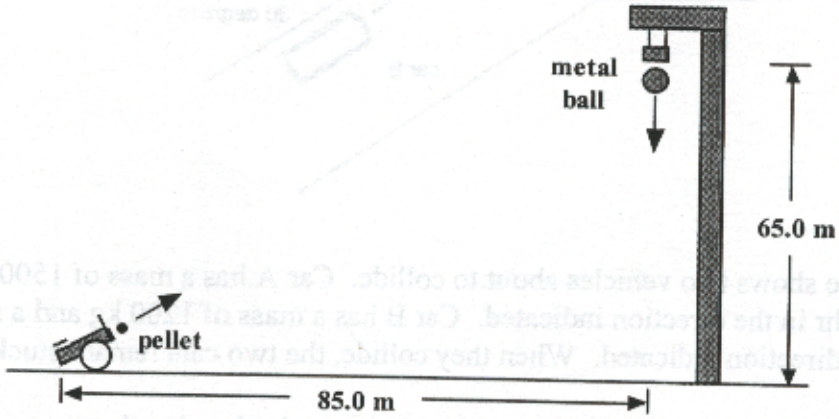
Read each question carefully and write your response in the space provided. Show calculations for numerical problems.

41.



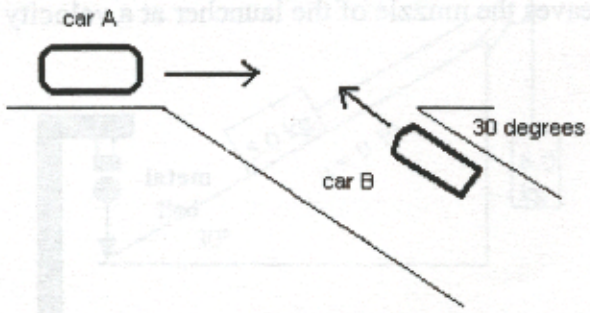
Determine the acceleration of the system. Include a free body diagram in your solution. **value: 4**

42. A metal ball is dropped at the same instant that a pellet is fired from a launcher as shown in the diagram below. The pellet leaves the muzzle of the launcher at a velocity of 53.0 m/s in the direction of the metal ball.



In a few sentences explain why the fall of the pellet from its initial path is the same as the vertical distance fallen by the metal ball. Your answer should include appropriate physics terminology. **value: 3**

43.



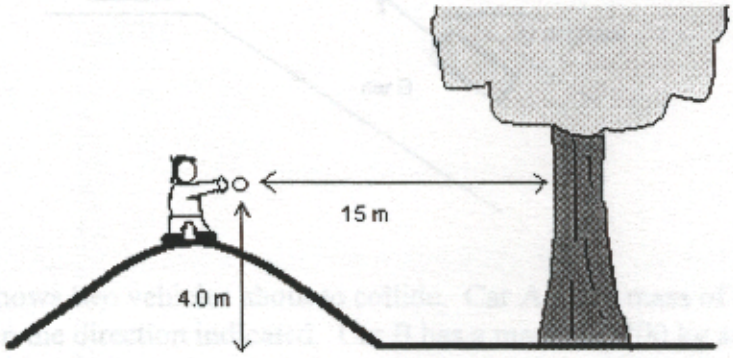
The diagram above shows two vehicles about to collide. Car A has a mass of 1500 kg and a speed of 50.0 km/hr in the direction indicated. Car B has a mass of 1200 kg and a speed of 40.0 km/hr in the direction indicated. When they collide, the two cars remain stuck together.

A) In the space provided, construct a diagram in relative scale showing the momentum of each vehicle before impact, the total momentum before impact, and the total momentum after impact. **value: 2**

43. B) Determine the final velocity of the combined mass after impact. **value: 2**

C) How does the total kinetic energy after impact compare quantitatively to the total kinetic energy before impact? **value: 1**

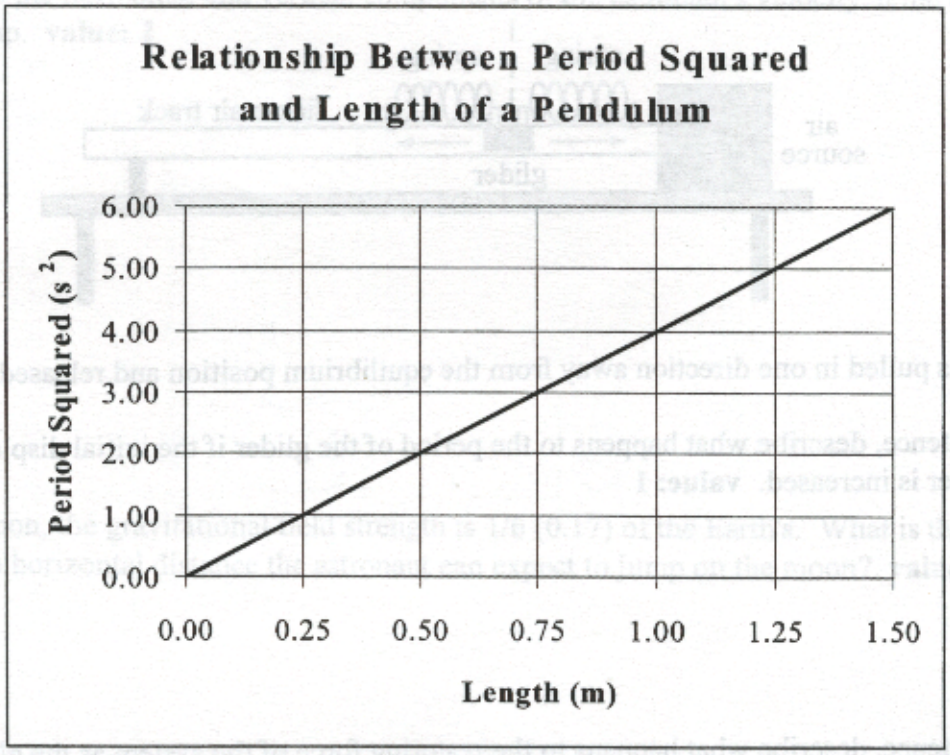
44. A child standing on a small hill throws a snowball at a tree that is 15 m away. When the snowball is released, it is 4.0 m above the ground on which the tree stands. The snowball hits the tree 0.60 s after it is released.



Determine the initial velocity of the snowball and how far above the ground it hits the tree. **value: 3**

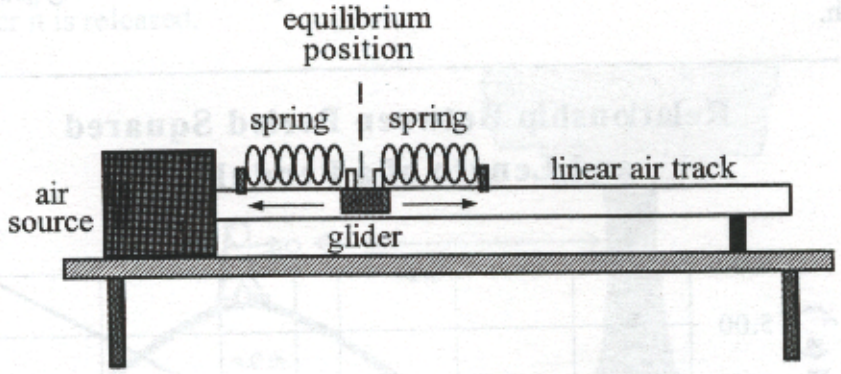
45. What is the orbital speed of a satellite in orbit about the earth at an altitude of 150 km above the earth's surface? **value: 3**

46. Some students conducted an experiment to determine the gravitational field strength of Earth. They timed pendula of various lengths and used the data to plot the following graph of period squared vs length.



Using this graph, determine the acceleration of gravity. **value: 3**

47. Students set up a glider on a frictionless air track as shown in the diagram below.



The glider is pulled in one direction away from the equilibrium position and released.

A) In a sentence, describe what happens to the period of the glider if the initial displacement of the glider is increased. **value: 1**

B) In a sentence, describe what happens to the restoring force of the system as the glider moves farther from the equilibrium position. **value: 1**

C) In a sentence, describe what happens to the speed of the glider as the glider moves farther from the equilibrium position. **value: 1**

D) In a sentence, describe what happens to the period of the glider if the mass of the glider is increased. **value: 1**

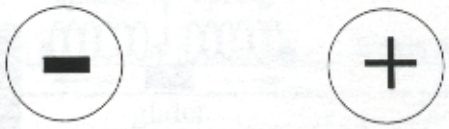
48. On the surface of Earth, an astronaut is able to run and jump a maximum horizontal distance of 1.3 m. During the jump, the astronaut is in the air 0.52 seconds.

A) Determine the horizontal and vertical components of the astronaut's velocity at the beginning of the jump. **value: 2**

B) On the moon, the gravitational field strength is 1/6 (0.17) of the Earth's. What is the maximum horizontal distance the astronaut can expect to jump on the moon? **value: 3**

49. On the diagrams below, draw in appropriate lines to describe the field near the objects shown. **value: 4**

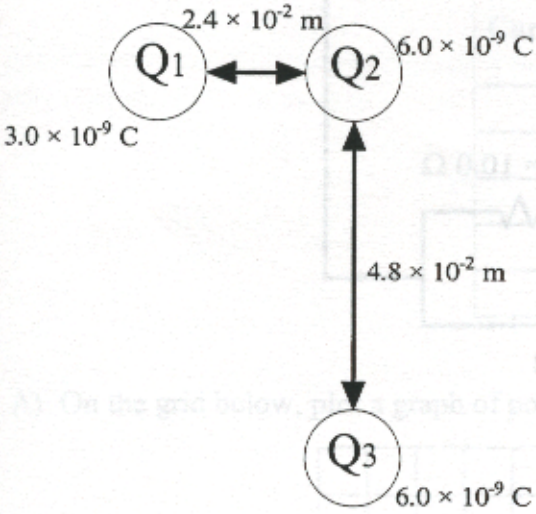
A)



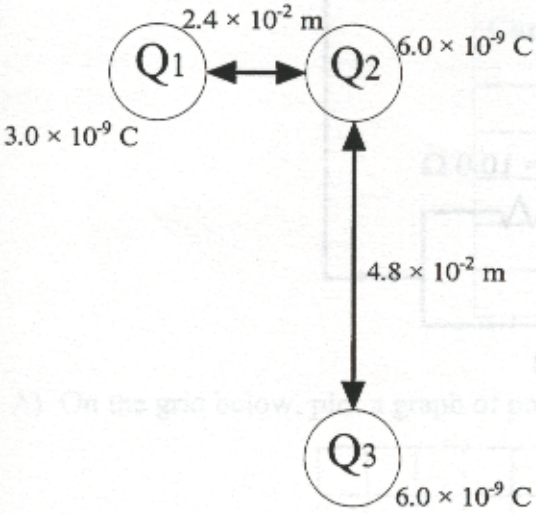
B)

50. Determine the electric force between two charged spheres placed 5.0 cm apart if one sphere has a charge of 4.0×10^{-6}C and the other sphere has a charge of 6.0×10^{-6}C ? **value: 2**

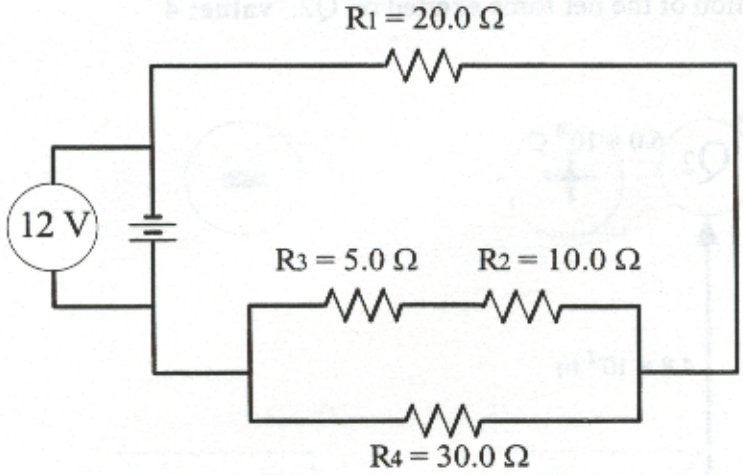
51. Three positively charged spheres are arranged as shown in the diagram below. Q1 has a charge of 3.0×10^{-9}C , Q2 has a charge of 6.0×10^{-9}C , and Q3 has a charge of 6.0×10^{-9}C . Determine the magnitude and direction of the net force exerted on Q2. **value: 4**



51. Three positively charged spheres are arranged as shown in the diagram below. Q1 has a charge of 3.0×10^{-9}C , Q2 has a charge of 6.0×10^{-9}C , and Q3 has a charge of 6.0×10^{-9}C . Determine the magnitude and direction of the net force exerted on Q2. **value: 4**



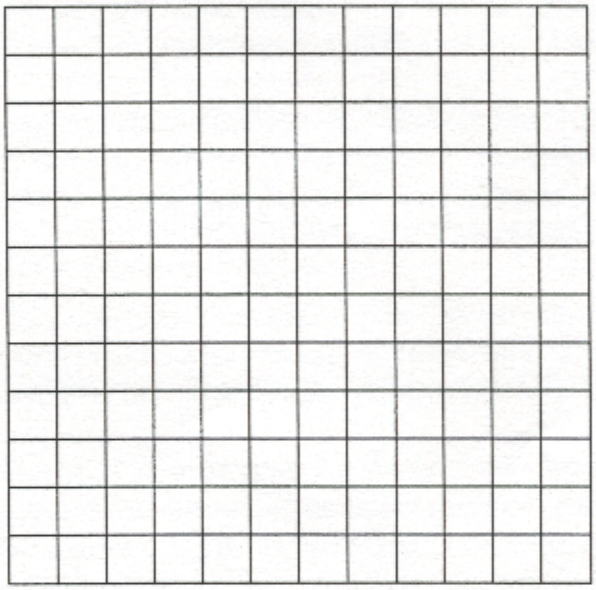
52. In the following circuit, determine the equivalent resistance of the circuit, the total current, and the current through R2. **value: 5**



53. Students studying Ohm's Law set up a circuit containing a power source, an ammeter, a voltmeter, and a resistor. During the trials, the resistance remained constant. The following data table shows the potential difference across and current through the resistor for several trials.

Current (A)	Potential Difference (V)
2.00	42.0
3.00	52.0
4.00	79.0
5.00	103.0
6.00	115.0

A) On the grid below, plot a graph of potential difference versus current. **value: 3**



B) Using your graph, determine the value, in ohms, of the resistance used in the experiment. **value: 2**

Case Study
(Total Value:10)

There are two parts to this section, both of which relate to the radioactive unit in Physics 12.

After reading the information supplied for each part, read the questions carefully and write your response in the space provided.

54. The following information relates to the irradiation of food. Read it and respond to question 54 that follows.

Food irradiation is the process of exposing either packaged or bulk food to carefully controlled amounts of ionizing radiation for a specific time to achieve certain desirable objectives. The process cannot increase the normal radioactivity level of the food, no matter how long the exposure or how large the dose. It can prevent the division of living cells, such as bacteria, by changing their molecular structure. It can slow down ripening of certain fruits and vegetables by causing biochemical changes in the physiological processes of plant tissues. It is effective in the "cleaning up" of harvested foods like fruit and spices.

The process is seeing increased use worldwide for foods from spices to vegetables and deboned chicken. A worldwide standard for the use of food irradiation was adopted in 1983 by the Codex Alimentarius Commission of the Food and Agriculture Organization of the United Nations. It is based on international studies that showed irradiation of any food commodity up to a dose of 10 kilogray "presents no toxicological hazard" and requires no further testing. This dosage "introduced no special nutritional or microbiological problems" in foods.

Governments are interested for many reasons. Worldwide loss due to infestation, contamination, and spoilage is high; there is mounting concern over food-borne disease; there is growing international trade in food products that must meet stiff standards of quality and quarantine - all concerns which irradiation can help address.

Worldwide losses to insects, bacteria, and rodents after harvest exceeds 25%. Irradiation can help with some food preservation and reduce the dependence on chemical pesticides. Sprouting of root and tuber crops makes them unmarketable. Sprouting can be delayed by irradiation.

The type of radiation used is limited to high energy gamma rays, X rays, and accelerated electrons. They are referred to as ionizing radiation because their energy is high enough to dislodge electrons from atoms resulting in electrically charged particles called ions. X rays are generated by machines. Gamma rays are produced naturally by the spontaneous disintegration of some nuclides such as cobalt 60, which is produced by the bombardment with neutrons of cobalt 59. Cobalt 60 has a half-life of 5.3 years.

Irradiated food is not radioactive food. Trace amounts of radioactivity is present in all of our environment, including food. A banana, for example, contains potassium, which includes some naturally occurring radioisotopes. The radioactivity induced by irradiation would be more than 200 000 times smaller than the naturally occurring decay rate.

In general, the irradiation process produces very little chemical change in food. Some of the changes include so-called "radiolytic" products such as glucose, formic acid, and acetaldehyde. These are naturally present in all food products at some level and are increased in amount by heat processing. No evidence has been found in thirty years of research that these products are harmful. Furthermore, no products unique to the irradiation process have been identified.

In the 1970's, a National Institute of Nutrition study in India reported a link between food irradiation and polyploidy, a situation in which a cell has a multiple of the normal number of chromosomes. Rats fed irradiated grain had a higher incidence of polyploid cells than rats fed regular grain. This result has never been duplicated, and the research has generally been discredited. In any case, polyploidy is a normally occuring genetic change that seems to have no significance for the organism.

The presence of some organisms can indicate spoilage. Irradiation can result in the suppression of these organisms, as does heat pasteurization and some packaging techniques. Only foods of good hygienic quality should be irradiated, and the handling of the food after processing must meet high standards, the same as with any food preservation process.

The building and operation of food irradiation facilities is tightly controlled by government regulation internationally. Approval, inspection, and tracking of irradiation sources is closely monitored. The cost of irradiation is often less than alternative methods. Although some consumers still confuse "irradiated" food with "radioactive" food, marketing studies have consistently shown that consumers prefer irradiated product to non-irradiated product when given the choice because of appearance and quality.

Adapted from pamphlets produced by the International Consultative Group on Food Irradiation.

54. Suppose that a bill has been introduced into the Nova Scotia Legislature that would:
    A) ban the use of food irradiation in the province
    B) prevent irradiated foods from coming into the province

    As the member of the legislature for Beenthere riding, you will have to make a speech in the House opposing the bill. Prepare a set of notes in outline form using the information in the previous article from the point of view of Nova Scotia consumers and producers. **value: 4**

55. There is no doubt that this century will see an ever increasing demand for energy worldwide. Producing and delivering the energy where it is needed will be a challenge. There will also be increasing concern for the environment. You have been asked to speak on the affirmative side in a debate of the following resolution.

Be it resolved: Canada should develop more nuclear powered electric generating stations to meet the energy needs of the twenty-first century.

Prepare a 300-400 word draft of a speech in support of the resolution using the following information. Be sure to address these points: fuel supply now and for the future, fuel cost, impact on the environment, and risk to human life. **value: 6**

ENERGY EQUIVALENTS FOR VARIOUS ENERGY SOURCES

Source	Tonnes of coal to Replace 1 T fuel
Breeder Reactor	1 300 000
Candu Reactor	20 000
Light Water Reactor	16 000
Oil	1.5
Coal	1.0
Peat	0.25
Oil Shale	0.15
Geothermal Steam	0.10

RELATIVE COSTS OF FUEL ($Can)

Year	Uranium 1 fuel bundle	Coal 400 T	Oil 1800 barrels
1988	$3055	$27 000	$33 000
1994	$2000	$16 000	$22 000
2000	$2400	$28 000	$50 000

55. **ATMOSPHERIC POLLUTION AND SOLID WASTE FROM WORLD ENERGY USE (millions of tonnes)**

Source	sulphur dioxide	nitrogen oxides	particulates	carbon monoxide	carbon dioxide	waste
coal	100	10	500	3	9000	200
gas	<0.5	2	<0.5	5	4000	minor
oil	40	10	2	200	9000	15
wood	0.2	3	100	200	5000	50
nuclear	0	0	0	0	0	0.04
hydro	0	0	0	0	0	0

These figures are approximate. Gasoline use in cars produces about 200 000 000 tonnes of carbon dioxide yearly worldwide. In the waste column, only nuclear waste is totally managed and controlled.

TOTAL RISK PER MEGAWATT YEAR ENERGY OUTPUT

Source	**Person Days Lost**	**Note**
coal	2000	
oil	1800	
nuclear	10	Too High Estimate based on inappropriate low dose hypothesis
natural gas	7	Too low Estimate does not include disaster fires like Kobe and California quakes

Supply notes No large scale hydro generators are planned. Natural Resources Canada estimates that Canada has a reserve of coal that could last 100 years. Worldwide reserves of oil are also estimated at 60-100 years. Canada's natural gas reserve is large and growing. The price, however, is more closely tied to the world oil price than in the past. Uranium supply is ample for hundreds of years.

55. **LOG SCALE OF RADIATION DOSES**

in millisieverts

100 000	acute dose to thyroid: cancer therapy largest annual dose from radon in Cornwell tin mine
10 000	dose to Chernobyl firemen who died leukemia treatment largest annual dose from radon in a British home
1 000	astronaut dose in space from cosmic radiation

no obvious effects below 200 millisieverts acute dose

100	annual dose from tobacco to pack a day smoker
10	annual dose to commercial flight crew CAT scan dose
1	background (2) average annual dose to workers at Point Lepreau power
0.1	typical chest x-ray annual dose from fallout from past bomb tests
0.01	annual dose from luminous signs, TV, smoke detectors
0.001	annual dose to local residents from Lepreau nuclear plant

55. **LOSS OF LIFE EXPECTANCY (COHEN, 1990)**
given in days of lost life from North American average expectancy

Activity	LLE (days)
living in poverty	3500
being male (vs female)	2800
cigarettes (male)	2300
heart disease	2100
coal miner	1100
30 lb overweight	900
military service	400
car accidents	180
drug abuse	100
homicide	90
air pollution	80
married to smoker	50
radon in homes	35
fire, burns	27
coffee, 2.5 cup/day	26
work in radiation environment	25
birth control pills	5
peanut butter, 1 Tbsp/day	1.1
major storm	1
air crash	1
living near a nuclear plant	0.4