Level 2 Physics
2013
Study Booklet of Madness

2013 L2 PHY EXAM: starts at 2pm
Wednesday the 13th of November

To prepare yourself for the NCEA externals in Physics you should be comfortable with the following:

- **<u>Vocabulary</u>** (terms, definitions, symbols and units)
- **<u>Equations</u>**: (even though you DON'T have to memorize them, know what types of problems go with certain ones!)
- **<u>How your exam will be marked</u>**: (this may influence how you target your work if you run short of time)
- The EXACT **<u>language of the NCEA standard</u>** – know what you can be examined on – and what's NOT on the exam!
- The **<u>National External Exams</u>** and **<u>old Term 3 TGS exams</u>**: (found online and in this booklet)

AND time-management skills

– know that you only have 3 hours to work on 3 booklets

Mechanics ≈ 60 minutes – 6 credits

Electromagnetism ≈ 60 minutes – 6 credits

Waves ≈ 60 minutes – 4 credits

3 - Step Method to Survive Revision:

Step 1: Review what you know and list what you don't know

Step 2: Focus on what you don't know
(use whatever you have to learn it)

Step 3: Repeat steps 1 and 2

Level 2 Physics 2013 Study Booklet Table of Contents:

You should also receive an answer booklet with:

Answers to equation descriptions and usages, vocabulary matching exercises and question sets

The look and marking of your exams:

You should understand how your exams will look and be marked.
It is essential that you attempt to answer each and every question's part.
If you realize that you're running short of time the knowledge of how your exam is marked may influence how you target your remaining time.

The look of your physics exams:

- Each of your 3 exams will have 3 or 4 large questions, each with 3 to 5 parts (a, b, c, d…) in 8 to 12 pages.
- At least 1 of these parts will have an answer up to excellence-level (usually 2). Many times there will be 1 mathematical E-level part and 1 descriptive or paragraph E-level part.
- To get excellence you usually will have to overtly link your descriptive answer to the context of the question, instead of just regurgitating theory. (See the section on page 6 for more info on this).
- Sometimes an E-level or M-level question will have bullet-points to help guide your answer. Attempting even 1 or 2 of these bullet points should get you some marks even if you cannot fully answer the question.

The marking of your exams:

- Physics exams, like all of your externals in any subject, will be marked with the 8-point system to make a "total score" that will then be turned into your final mark: N, A, M or E.
- To get this each question will get 0 to 8 points based on all of your answers in that single question: N_0, N_1, N_2, A_3, A_4, M_5, M_6, E_7 and E_8.
- Your total will be added:

  For a 3 question test (max of 24 points) the A, M, E **minimum** thresholds:
  - A = ¼ x 24 + 1 = 7
  - M = ½ x 24 + 1 = 13
  - E = ¾ x 24 + 1 = 17

  For a 4 question test (max of 32 points) the A, M, E **minimum** thresholds:
  - A = ¼ x 32 + 1 = 9
  - M = ½ x 32 + 1 = 17
  - E = ¾ x 32 + 1 = 25

  WARNING: these are the minimum thresholds. The chief marker of each exam can adjust them upwards by 1 or 2 depending on the easiness or difficulty of the exam after you've taken the test. Each test's thresholds will be posted in the NCEA exam website by the time you get your exams back in January.

The marking of a single question:

- Most physics exam questions will have 3 or 4 parts (a, b, c, d) instead of a single long essay like biology.
- The usual minimum to get A_3 will be to get *2 parts correct at some level*. But if the question has 4 or 5 (or more) parts you may need to get *more than half parts correct* at some level to get A_3.
- If you only answer 1 or 2 parts of an entire question correct at some level you may only get N_1 or N_2, depending on how many parts the question has.
- Similarly, to get M_5 you will usually need to get *half* (or 1 more than half) of the possible M-level answers.
- And to get the elusive E_7 you will need at least 1 of the E-level answers. To get E_8 you will need either 2 E-level answers or a complete single answer if only 1 part leads to excellence.
- We have been told that your exam will be marked from "top down". This means the marker will look to see if you get E_8 or E_7 before working out if you get M_5 or M_6… and then finally look for evidence of A_3 or A_4 before N_2, N_1 or N_0.
- **WARNING:** This "top down" marking approach ***DOES NOT*** mean that you should only answer the E-level parts. ***You should try to answer each and every part of every question***. Answering even 1 or 2 parts of a tough question may give you the needed 1 or 2 points to pull you over the A or M threshold.

Techniques on Significant Figures (and units):

As you probably know, *at least once* on each of the 3 exams you should be asked to round your answer to the proper significant figures or give proper units. Remember to round off to the ***smallest*** number of significant figures used in your calculation.

Example 1: for Sig. Fig. d = 3.45m, (3 sig fig) t = 54s (2 sig fig)

v = d/t = 3.45/54 = 0.063888… ≈ **$0.064ms^{-1}$ (2 sig fig)** – smallest of 2 and 3 sig fig numbers

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Example 2: $v = 3.00 \times 10^8 ms^{-1}$ (3 sig fig) $f = 1.405 \times 10^{14}$Hz (4 sig fig)

$\lambda = v / f = 3.00 \times 10^8 / 1.405 \times 10^{14} = 0.000002125 = 2.125 \times 10^{-6} \approx$ **2.13×10^{-6} Hz (3 sig fig)**

Techniques on "SHOW" Questions:

"Show" questions give you the answer – you must show ***all steps*** (including rounding) that give that answer. Most of these are "achievement" level but they can be higher.

The FIVE minimum steps:

1. Write the **equation** used (with letters or symbols)
2. Write the **rearranged equation** for the value wanted (with letters or symbols)
3. Write the rearranged equation with the **numbers given substituted** in the proper places
4. Write the **unrounded answer** from the rearranged equation
5. Write the **rounded answer**

Example 1:

As they are moving away from the boat ramp they travel at a steady speed of **$1.4 ms^{-1}$.** Once they pass the 200m marker they accelerate uniformly for **5.5 seconds** reaching a speed of **$10 ms^{-1}$**. Show that the acceleration of the boat is **$1.6 ms^{-2}$.**

Answer 1: $v_f = v_i + at$ gives: $a = (v_f - v_i)/t = (10-1.4) / 5.5 = 1.563\ldots \approx$ **$1.6 ms^{-2}$**

Example 2:

Bill's uncle is in a rubber inflatable boat that has a total mass of **180 kg**. Bill and his dad are following the inflatable in their fiberglass boat (total mass = **1080 kg**) and accidentally bump into it from behind. At the instant of the collision Bill's boat is traveling at **$4.3 ms^{-1}$** and his uncle is traveling at **$3.5 ms^{-1}$.** Immediately after the collision, the rubber inflatable boat is traveling at **$4.8 ms^{-1}$.** The **change in momentum** is **$230 kgms^{-1}$.**
Show by appropriate calculations whether the collision is elastic or inelastic.

Answer 2: $E_k = \frac{1}{2} mv^2$ Total E_k before = $(0.5\times1080\times4.3^2) + (0.5\times180\times3.5^2)$ = **11,087.1J**
Total E_k after = $(0.5\times1080\times4.1^2) + (0.5\times180\times4.8^2)$ = **11,077.35 J**

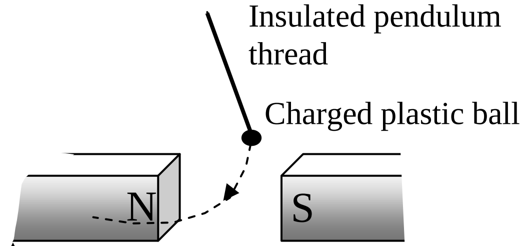
If significant figures are taken into account both the energy before and after are 1.1×10^4 J and so the collision is elastic.

Techniques on Graphs:

- When a question asks for a "sketch" of a graph the minimum mark usually requires the ***correct shape***.
- ***Label both axis*** (if they have not done that for you) with symbols and units
- If you can find or calculate or know the ***number values*** for the axis – **put them on your graph!**

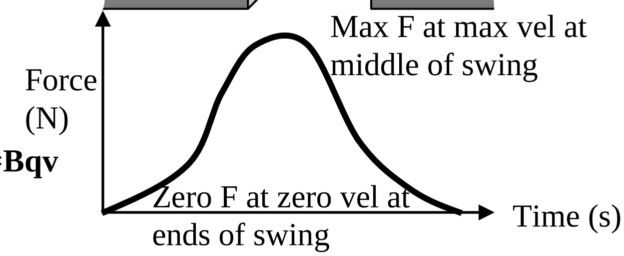
Example 1:

The wire and circuit used in (a) is removed and a small plastic ball hanging on a pendulum is given a **negative** charge of **3.9×10^{-5} C** and allowed to swing through the magnetic field as shown in the diagram. The maximum speed of the ball as it passes through the magnetic field is **2 ms^{-1}**. The magnetic field strength is **0.13 T.** ***Sketch*** the expected shape of the force-time graph as the ball swings across once between the magnetic poles



Answer 1:

Uses F=Bqv



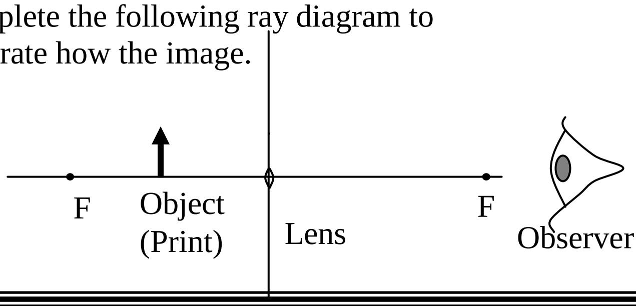
Techniques on Ray-Diagrams and Vector Diagrams:

For ray-diagrams, force, momentum or other vector diagrams make sure you:

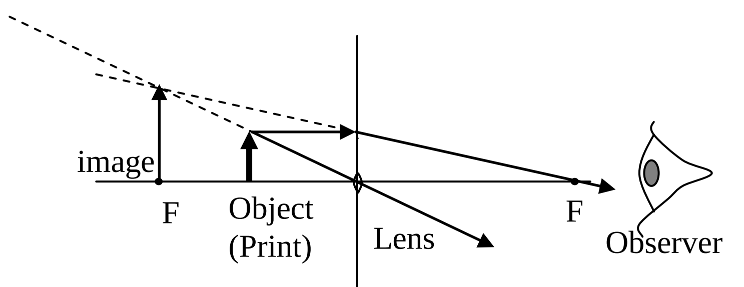
- Label each arrow with its **symbol or name – or *ARROW-HEADS* for ray diagrams**
- **Ray-Diagram: solid** lines for light. **Dotted** lines for virtual image rays (not light)
- Draw the length of each arrow in ***relative size*** to the others
- If you know the angles – draw the arrows with proper **estimated directions**
- If you know the magnitude (size) or can calculate it – include the **number (with units)**

Example 1:

Complete the following ray diagram to illustrate how the image.

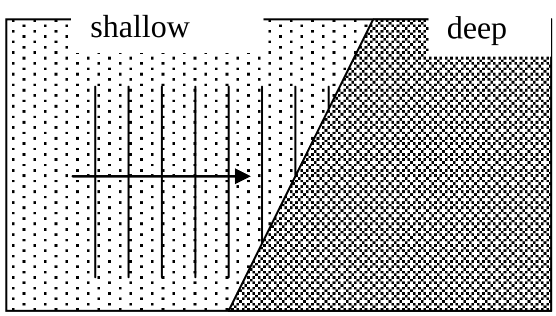


Answer 1:

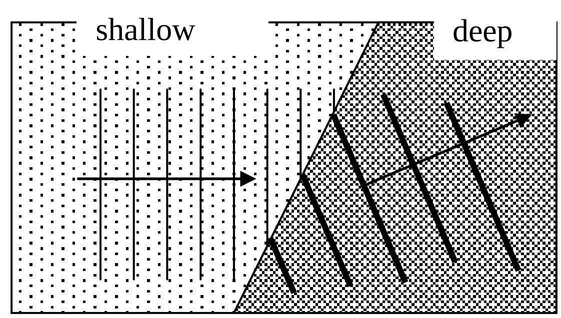


Example 2:

A wave-train is travelling through water in a shallow pool and passes into a deeper region as shown. On the diagram sketch the waves as they travel through the deep region.

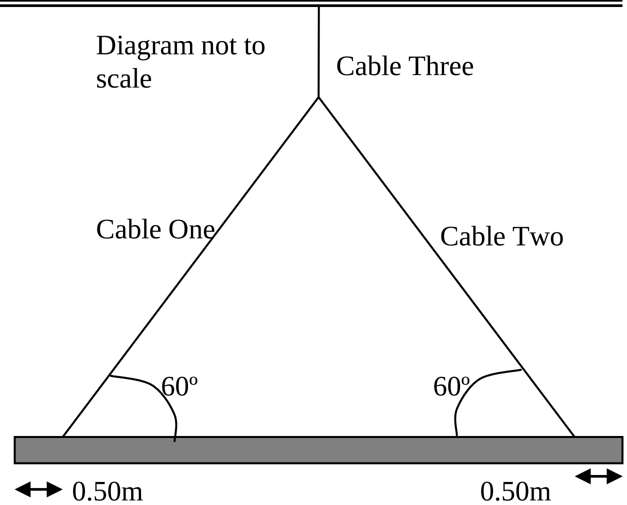


Answer 2:



Example 3:

The diagram below shows an arrangement of a 1000kg beam and the steel cables that connect it to the crane.



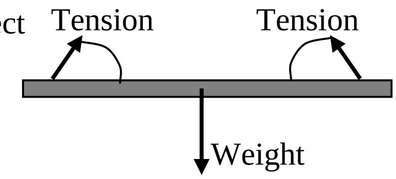
(c) The beam is being lifted at constant velocity

(i) Draw labeled arrows on the diagram to represent each of the individual forces acting **on the beam**.

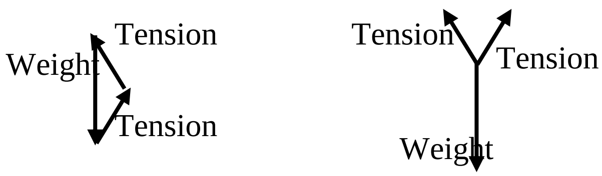
(ii) Sketch a labeled vector diagram to show how these forces in (i) can be combined to give the net force acting on the beam.

Answer 3:

(c) i Achieved only answer: 3 arrows and labels correct



(c) ii Merit level answer: either diagram is correct



Techniques on Explanation Questions

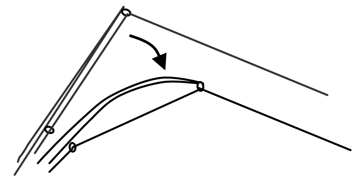
1. Identify **Key Words** and/or possible principles (eg cons of mom, energy, force)
   - if you answer the question WITHOUT these key words you will NOT be given credit
   - even if you say something totally true!
2. Draw **picture**
   - especially if the exam paper gives you room or asks you to!!!
3. List **quantities** involved (eg, force, mass, angular speed etc)
   - if you know the amount or numbers, or can quickly calculate them, then DO IT and include them in your answer
4. Write **formula** and or **principle** into your explanation
5. Overtly **link your theory to the situation involved** (to get E)
6. "If, then, because" formats can come in handy
   - explain formula in words and exactly how the variables affect each other

Checks at end:

- No "I think"
  - this is considered "fluff" or "useless filler"
  - Physics teachers want you to get straight to the answer – no messing about!
- Have I waffled? - these may stop you from getting "excellence"
- No repetition these may stop you from getting "excellence"
- No contradictions
  - these may delete any other "correct" information in your answer!!!
- Check that your answer **answers the question** and relates to the topic on exam.
- Have you mentioned how the **situation links to the physics theory**?

Example 1: In practice, the path of the fishing lure would not be a symmetrical parabola. Comment on why.

Answer 1: **<u>Core ideas</u>**: Friction **AND** drag.
<u>FULL ANSWER</u>: A parabolic flight path assumes that the only force operating on the lure is gravity and so the horizontal component of the velocity is constant. However because the lure is attached to a line, there will be an increasing tension force from the line caused by friction, as well as drag from its path through the air slowing its horizontal velocity component and distorting its parabolic motion.



Example 2: In practice the end of the rod bends as shown in the diagram. Explain, in terms of the forces operating, how this bending of the rod near its tip makes it "easier" to pull in the fish.

Answer 2: When the rod bends near the tip the distance from the pivot to the force caused by the fish is reduced. This means that the torque (Fxd) produced by the fish on the pivot of the rod is reduced. Thus less force is required to be applied by Bill's left hand on the rod to balance the torque from the fish. Ie for excellence, ideas must be clearly linked as consequences of each other.

Example 3: Comment on the advantages and disadvantages of series (A) and parallel (B) circuits.

Answer 3: <u>Advantages</u> of Circuit A over circuit B. A has Low current. B has high current which is expensive. <u>Disadvantages</u> A has 1 light out all out. B has other lights still working. A very dim, not up to power. B very bright, all at rated power.

Example 4: A boy is swimming under water next to a boat and looks up through the water at the green navigation light on the boat. The boy is not wearing any goggles (goggles are underwater swimming glasses). The rays of green light from the boat slow down as they pass into the water.
Assuming that colour is a sensation produced by the interaction of light with the retina at the back of the eye, comment on whether you think the boy would still see the light as its normal green colour. Explain your answer giving reasons.

Answer 4: Sees green light. Although the light slows down and the wavelength changes the frequency remains the same. So when the light enters the boy's eye its speed and wavelength become that which is characteristic for that frequency and which the boy always sees as green.

Level 2 Physics Maniacal Mechanics Matching Madness

(plus common other things)

1. accelerate	a) involved by reading a scale from an angle	2. acceleration due to gravity	b) alternative name for pivot
3. accurate	c) stored in gravitational field when object is moved away relative to Earth	4. average velocity	d) quality that involves magnitude only
5. centripetal acceleration	e) inwards acceleration as object moves in circular path	6. centripetal force	f) alternative name for standard form
7. collisions	g) the rate of change of dependent variable to independent variable in a graph	8. components	h) quality used to describe how steep a straight line is
9. conserved	i) force needed to keep object moving in circular path	10. continuous variable	j) alternative name for torque
11. couple	k) the rate of change of velocity	12. deceleration	l) quantity that requires a direction
13. displacement	m) length between two positions	14. distance	n) alternative term for scientific notation
15. elastic potential energy	o) time taken for one revolution or event.	16. force	p) rate at which objects change with velocity when dropped on Earth
17. frequency	q) makes the measurement consistently larger (or smaller) than the true value	18. friction	r) another term for resultant
19. fulcrum	s) total displacement divided by total time	20. fundamental units	t) rate of change of displacement
21. gradient	u) makes the measurement equally likely to be more or less than the true value	22. gravitational potential energy	v) any type of graph that makes a straight line with any gradient
23. hertz	w) turning or twisting effect about a pivot	24. impulse	x) rate of change of displacement at a particular instant
25. inelastic	y) measurement close to actual value	26. instantaneous velocity	z) apparent movement of two objects due to the movement of the observer
27. joules	aa) two equal and opposite forces that act at perpendicular distance apart to cause rotation	28. kinematic equations of motion	bb) rate of change of displacement of one object in relation to another
29. kinetic energy	cc) negative acceleration	30. linear	dd) can take any value within a range of values
31. moment	ee) two vectors at right angles which, when added together, are equal to a single vector	32. momentum	ff) rate of change of distance
33. net	gg) number of revolutions or events in one second	34. parallax	hh) change in momentum produced by a force acting for a length of time
35. parallax error	ii) used only when acceleration is not changing	36. period	jj) rate of change of distance of electromagnetic spectrum in vacuum
37. power	kk) object following parabolic path under the force of gravity	38. precise	ll) digits in a number or measurement that are not being used as place holders
39. projectile	mm) when measurements are closely grouped together	40. proportional	nn) rate of doing work
41. random error	oo) physical quantities that can have a range of values	42. relative velocity	pp) distance traveled measured from start position to finish
43. resultant	qq) when something stays constant	44. rounding error	rr) seven units of the SI system from which all others can be derived
45. scalar	ss) physical quantity of the mass multiplied by the rate of change of displacement	46. scientific notation	tt) equivalent single vector when two or more vectors are acting on an object
47. significant figures	uu) when the measuring scale does not give accurate value for nil measurements	48. slope	vv) SI unit for the number of cycles per second
49. speed	ww) process of transforming energy form one form to another	50. speed of light	xx) force in connected strings and ropes that tries to stretch them
51. spring constant	yy) when two or more objects interact	52. standard form	zz) SI unit of energy

53. systematic error	aaa) produced when two surfaces come in contact	54. tension	bbb) force required to compress or extend a spring one metre
55. torque	ccc) when two qualities are related by a constant ratio	56. uncertainty	ddd) SI unit of rate of change of work
57. variables	eee) property of object while in motion	58. vector	fff) how a measurement could differ from the true value
59. velocity	ggg) where kinetic energy is not conserved in collision	60. watt	hhh) stored in an extended or compressed spring
61. work	iii) push or pull in a particular direction	62. zero error	jjj) introduced into calculations caused by using partial previous answers

Level 2 Exotic Electricity and Magnetism Matching

1. alternating current	a) gives off light when current passes through them but use very little voltage
2. ammeter	b) where iron or moving charged particles experience a force
3. ampere	c) tool for measuring the rate of change of charge
4. armature	d) wire wound around and around
5. carbon	e) generator that uses friction to build up very high potentials
6. circuit	f) region in which a charged object experiences a force
7. conventional current	g) the size of the force on a charge is proportional to the distance squared and the other charge
8. coulomb	h) where the number of positive and negative charges are equal or not present at all
9. coulomb's law	i) generation of voltage across a wire
10. current	j) rate of movement of charge
11. diode	k) term for the number of wrappings of wire in solenoid
12. direct current	l) where lines of force or action are parallel and equally spaced
13. electric field	m) first to measure the size of the charge on a single electron
14. electric field lines	n) rate of doing work
15. electric potential energy	o) stored by moving a charge against an electric field
16. electromagnet	p) when lines of force or action move away (or into) in every direction from central point
17. electromagnetic induction	q) electrons travel the other way
18. electrons	r) quantity that requires a direction
19. emf	s) steady flow of electrons in one direction only
20. galvanometer	t) when heat energy is used to cause atoms to shake off their electrons
21. generator	u) does not alter the ability to retard the movement of electrons
22. graphite	v) quality of material to retard movement of electrons or ions
23. heat	w) SI unit of the rate of movement of charge
24. induction	x) what every resistor produces
25. joules	y) difference in voltage between parts of a circuit
26. light dependent resistor	z) produces electric current from rotating coil inside magnetic field
27. light emitting diode	aa) SI unit of the magnetic field strength
28. magnetic field	bb) voltages and currents produced by changing magnetic fields
29. Milikan	cc) complete conductive path for electrons to return to power source
30. neutral	dd) produced when a current passes through a solenoid
31. neutron	ee) SI unit of rate of change of work
32. ohm	ff) very sensitive tool for measuring the rate of charge moving
33. ohmic conductor	gg) common term for potential difference
34. ohm's law	hh) process of transforming energy form one form to another
35. potential difference	ii) SI unit of quality of material to retard movement of electrons
36. potential divider	jj) uses two resistors to divide up an input voltage and make a smaller output voltage
37. potentiometer	kk) circuit with only one path for charged particles to return to power source
38. power	ll) positively charged nucleon
39. proton	mm) SI unit of energy
40. radial field	nn) used to control voltage (volume or tone controls in radios or amplifiers)
41. resistance	oo) changes ability to retard electron flow dependent on temperature
42. right hand slap rule	pp) orbit the nucleons
43. series	qq) SI unit for charge
44. solenoid	rr) used for brushes in motor for lubrication and conductivity
45. tesla	ss) changes ability to retard electron flow dependent on light intensity
46. thermistor	tt) material found in most common resistor type
47. thermonic emission	uu) semiconductor that allows current to flow one direction
48. turns	vv) uncharged nucleons
49. uniform field	ww) alternate term for coil of wire in

	motor	53. voltmeter	aaa) a source voltage
50. Van der Graaf	xx) map out the path a small positive test charge would move	54. watt	bbb) instrument for measuring potential difference
51. vector	yy) relationship between voltage, resistance and current	55. work	ccc) relates magnetic field, current and force on wire
52. voltage	zz) type of current produced in generators		

Level 2 Physics Wondrous Wave Matching

1. absolute refractive index	a) description of the three characteristics of an optical image
2. amplitude	b) lowest point on a wave
3. antinode	c) SI unit for the number of cycles per second
4. centre of curvature	d) where two or more waves add to give a zero resultant wave
5. constructive interference	e) curving inwards
6. concave	f) links refractive indices and refractive angles for different mediums
7. converging	g) scale drawing to find details of images formed by mirrors or lenses
8. convex	h) where two or more waves add to give a larger resultant wave
9. crest	i) curved outwards
10. critical angle	j) line of symmetry from the pole to the centre of curvature
11. destructive interference	k) ratio of the speed of light in vacuum to that in a medium
12. diffraction	l) where particles of the medium vibrate at right angles to the direction of the wave movement
13. diverging	m) curved mirror or lens that spreads light out as if from a point
14. diverging lens	n) line at right angles to the wave's direction of travel
15. electromagnetic waves	o) ratio of speed of light in one medium to another
16. equilibrium	p) where particles of the medium vibrate along the direction of the motion of the wave
17. focal length	q) curved mirror or lens that brings parallel rays together to a point
18. frequency	r) image that can be focused on a screen
19. gamma radiation	s) produced by curved mirrors or lenses
20. hertz	t) where light entering an optically less dense medium refracts at right angles
21. image	u) concave lens
22. lateral inversion	v) highest point on a transverse wave
23. longitudinal	w) place of maximum disturbance on a standing wave
24. medium	x) when wave is not allowed into a less optically dense medium
25. nature	y) change in speed and direction when wave enter a new medium
26. period	z) high-energy, electromagnetic radiation
27. phase	aa) number of revolutions, vibrations or events in one second
28. principal axis	bb) when two or more waves in the same region add together to give a resultant wave
29. principle of superposition	cc) centre of imaginary circle made by mirror or lens surface
30. pulse	dd) formed as a result of two waves with equal speed, frequency and wavelength travelling towards each other
31. radius of curvature	ee) method by which waves add together to give a resultant wave
32. ray diagram	ff) caused by the vibration of charged particles
33. real	gg) when a right hand is reflected to look like a left hand
34. refraction	hh) distance from the focus to the pole or optical centre
35. refractive index	ii) measure of how much one wave is out of step with another
36. snell's law	jj) bending of wave around a barrier or out through a gap
37. standing wave	kk) time taken for one vibration, wave, revolution or event.
38. superimpose	ll) distance from centre of curvature to the pole
39. total internal reflection	mm) maximum distance from rest or equilibrium
40. transverse	nn) an image that cannot be projected on a screen
41. trough	oo) situation when an object is at rest or moving uniformly as in Newton's First Law
42. virtual	pp) distance between adjacent corresponding points on a wave
43. wavefront	qq) material through which waves pass
44. wavelength	rr) single disturbance that moves through a medium

List of Web-Sites that cover more multiple topics:

Surendranaths:	http://www.surendranath.org/Applets.html
Hong Kong Physics Teacher Site:	http://ngsir.netfirms.com/index.htm
NZIP year 12 applet page:	http://nzip.org.nz/wordpress11/education/resources-for-teachers/sites-for-applets/y12-applets/
Lectures Online:	http://lectureonline.cl.msu.edu/~mmp/applist/applets.htm
Explore Learning:	http://www.explorelearning.com/
Colorado Uni:	http://www.colorado.edu/physics/2000/TOC.html
Walter Fendt's:	http://www.walter-fendt.de/ph14e/
Florida State Uni – List of Light Javas:	http://micro.magnet.fsu.edu/primer/lightandcolor/refractionhome.html
Florida State Uni – List of E-M Javas:	http://micro.magnet.fsu.edu/electromag/java/index.html
NZ Government Study Site	http://www.studyit.org.nz
NZ Government Site for NCEA material – standards, old exams, etc	http://www.nzqa.govt.nz/qualifications-standards/qualifications/ncea/subjects/physics/levels/
Colorado State Uni Java animations	http://www.colorado.edu/physics/2000/index.pl

Motion – P2.4 Part 1

Student Learning Outcomes

At the end of the unit students can: Graphs

E1	Explain the following terms (and use appropriate units): Distance, displacement, speed, velocity, average speed, average velocity & acceleration.
E2	Explain the difference between a vector quantity and a scalar quantity.
C3	Solve simple problems involving constant velocity or constant acceleration.
E4	Draw, explain the motion taking place and obtain information from distance-time, displacement-time, speed-time and velocity-time graphs.

Kinematic Equations

C5	Use kinematic equations to solve problems involving constant acceleration in a straight line.

Relative Motion

(optional but helps with force questions)

C6	Solve simple problems involving relative motion in 1 dimension.
E7	Understand and Use appropriate reference frames to solve problems involving vectors.
C8	Draw vector diagrams for vector addition and subtraction (1-D and 2-D) and use pythagoras theorem and trigonometry appropriately to find magnitude and direction of vectors.
C9	Use vector diagrams to discuss and calculate relative motion situations (river crossing, plane in wind, etc).

Projectile Motion

C10	Calculate vector components and Use them in vector diagrams when appropriate.
C11	Solve problems involving projectile motion. (ie finding vertical height, range, time taken, initial or final velocity.)
E12	Discuss path of projectiles with and without air resistance.

Forces and Torques – P2.4 Part 2

Student Learning Outcomes

At the end of the unit students can:

Forces: 1-D and 2-D

E1	Identify difference forces and their effects.
C2	Draw vector diagrams for vector addition and subtraction (1-D and 2-D) and use pythagoras theorem and trigonometry appropriately to find magnitude, directions of vectors and vector components.
E3/C3	Be able to discuss and apply Newton's 1st and 2nd laws of motion to various situations.
E4/C4	Describe the conditions required for equilibrium with regards to force.
C5	Use diagrams to determine net force in 1-D and 2-D
E6	Be able to discuss and apply Newton's 3rd law of motion.

Springs

C7	Explain meaning of extension, spring constant and apply Hook's law appropriately.
C8	Use $F = kx$ and $F = mg$ to determine spring constant, extension or mass
C9	Define and calculate (for a given situation) elastic potential energy and calculate the spring constant and energy stored using a force verses extension graph.

Circular Motion

E10	Explain why it has an acceleration and Indicate the direction of the velocity, centripetal force and centripetal acceleration.
E11	Define and use period and frequency in circular motion situations.
C12	Use formulae for centripetal acceleration and centripetal force appropriately.
C13	Calculate period, frequency, radius, speed, centripetal acceleration, or centripetal force when given appropriate information.
E14	Discuss how objects "feel" as they spin in circular motion compared to the forces that act on them.

Energy, Work, Momentum and Power – P2.4 Part 3

Student Learning Outcomes

At the end of the unit students can:

Torque

C1	Calculate torque in a given situation.
E2	Describe the 2 conditions equilibrium requires and Identify an object which is in equilibrium.
C3	Calculate the force or torque required to keep an object in equilibrium in a given situation and use diagrams to calculate masses, forces or distances involved in beam or scaffolding.

Energy and Power:

C4	Define and calculate (for a given situation) gravitational potential energy, kinetic energy and mechanical energy.
E5	Explain what is meant by conservation of energy and have an appreciation for the limitations of this concept.
C6	Explain the difference between an elastic and an inelastic collision and determine whether a collision is or is not elastic.
E7	Define work and state its units. (including the idea of work done as a transfer of energy)
C8	Calculate the amount of work done in a given situation.
E9	Identify situations where no work is done.
C10	Define power (and state its units) and calculate power in a given situation.
C11	Relate power to force and velocity or work done in a certain time

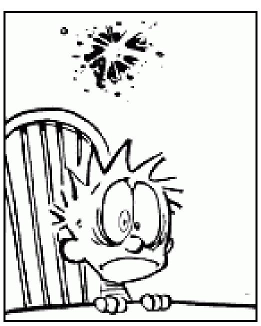
Momentum in 1-D

C12	Define momentum (state units & direction) and use the relationship between momentum, mass and velocity to solve simple problems.
E13	Explain what is meant by conservation of momentum and state when this applies.
C14	Solve 1-D problems involving conservation of momentum during collisions or explosions (2-D situations are optional but will help you next year in L3phy)
C15	Calculate change in momentum in 1-D (2-D situations are optional but will help you next year in L3phy).
C16	Define Impulse and use the relationship appropriately to calculate forces and time of collisions.

Static Electricity – P2.6 Part 1

Student Learning Outcomes
At the end of the unit students can:
Electrostatics and electric fields

E1	Explain the rules of attraction and repulsion.
E2	Understand and use the concept of electric field appropriately.
E3	Draw the electric field around various charged objects.
C4	Describe and draw the electric field between two plates, calculate its magnitude and determine its direction.
C5	Calculate the force on a charge in an electric field, give its direction and give an alternate unit for electric field.
C6	Understand the concept of electric potential energy as opposed to electric potential, calculate the electric potential energy in various situation and use the conservation of energy to determine the velocity of a charge at any point within the field.
C7	Describe the path of a charged particle in an electric field and use kinematic equations appropriately to determine properties of the particle.



DC Electricity – P2.6 Part 2

<u>Student Learning Outcomes</u>
At the end of the unit students can:

DC Circuits

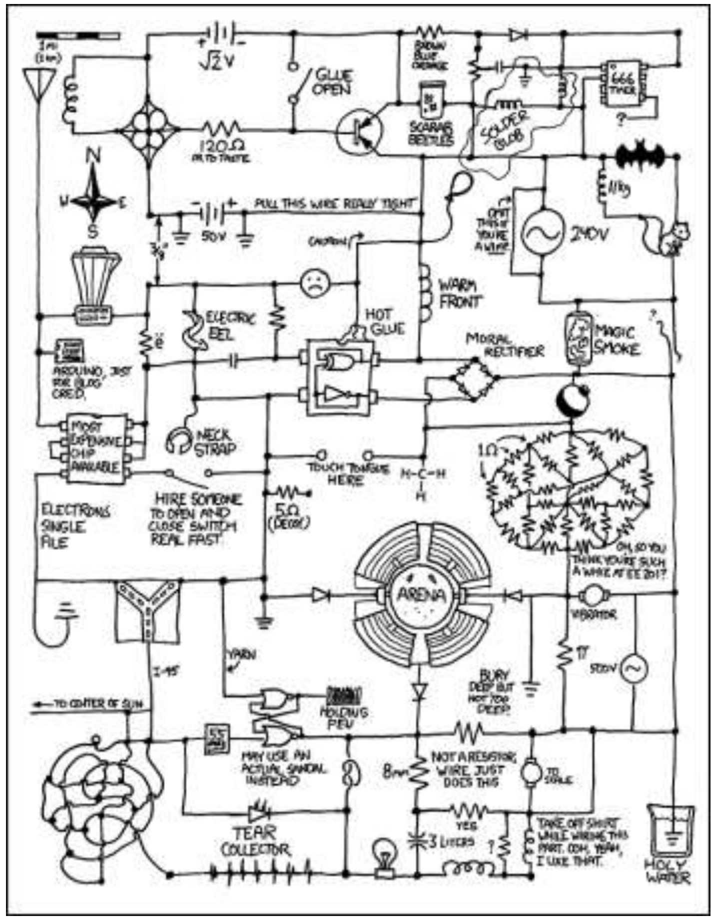
E1	Draw circuits using the correct symbols.
E2	Define the terms current, voltage, resistance, conductor and insulator.
C3	Explain the definition of current and use the equation $I = \frac{q}{t}$ appropriately
C4	Explain the definition of voltage and use the equation $V = \frac{\Delta E}{q}$ appropriately
E5	Describe the movement of electrons in a wire with or without an electric field.
E6	Define and describe the properties of a series circuit
E7	Define and describe the properties of a parallel circuit and Explain its advantages.
E8	Define the term resistance and Give its units.
C9	Use Ohm's Law to solve problems and predict changes within circuits with changing current, voltage or resistance including voltage dividers.
E10	Describe the factors affecting the resistance of a wire.
E11	Explain the differences between ohmic and non-ohmic conductors and draw V-I graphs
E12	OPTIONAL: Investigate properties of non-ohmic conductors (light bulb, LEDs, LDRs and thermistors), Relate these properties to voltage verses current graphs and Draw the V-I graph for a diode showing both the forward biased and reverse biased behaviours
C13	Calculate the resistance of various combinations of resistors.
C14	Discuss uses of voltage dividers and be familiar with circuit diagrams with them.
C15	Calculate the power dissipated in a circuit and relate it to the energy transformation taking place.
C16	Use P = IV appropriately to calculate values of power.

Electro-Magnetism – P2.6 Part 3

Student Learning Outcomes
At the end of the unit students can:

Electromagnetism

E1	Explain the rules of attraction and repulsion.
E2	Understand and use the concept of magnetic field appropriately.
E3	Draw the electric field around various combinations of magnets.
E4	Know and use appropriate conventions for going in and out of the paper.
C5	Draw the magnetic field around a wire and calculate its size (recognise that it is moving charge that creates this field).
E6	Draw the magnetic field inside and outside a solenoid and discuss its origin in relation to the current in the wires of the solenoid.
E7	Define the angle in $F = BIL(\sin\theta)$ and discuss how the force alters as the angle changes
C8	Calculate the size of the force on a current carrying wire (or a charge moving) when placed in a magnetic field. (give the direction using the right hand slap rule)
C9	Calculate the force on a charged particle moving in a magnetic field by the equation $F = Bqv$ and draw diagrams for the movement and forces on charged particles moving in magnetic fields by use of the right hand slap rule.
C10	Draw diagrams for induced voltage circuits and calculate its value using $V = BvL$.
E11	Discuss how to induce a voltage with a straight wire and a magnetic field and determine the direction of current in induced-voltage situations.
E12	**OPTIONAL:** Label and diagram a simple **motor** knowing the name and function of all parts, and understand how it works.
E13	**OPTIONAL:** Label and diagram a simple **generator** knowing the name and function of all parts, and understand how it works.



Light – P2.3 Part 1

Student Learning Outcomes

At the end of the unit students can:

E1	Differentiate and Identify concave and convex mirrors.
E2	Understand the terms convex, concave, pole, principal axis, centre of curvature, focal point and focal length when applied to curved mirrors.
E3	Use the construction rules to draw ray diagrams to locate images through concave mirrors.
E4	Draw ray diagrams and describe the 4 types of images possible with concave mirrors.
E5	Use the construction rules to draw ray diagrams to locate images through convex mirrors.
E6	Draw ray diagrams and describe the only type of images possible with convex mirrors.
E7	Describe applications of concave and convex mirrors.
E8	Understand the meaning of the symbols used in Descartes' formulae (d_o, d_i, h_o, h_i, m and f).
C9	Use Descartes' formulae appropriately to solve problem involving curved mirrors.
E10	Understand the meaning of the symbols used in Newton's formulae (S_o, S_i, m and f) for curve mirrors.
C11	Use Newton's formulae appropriately to solve problem involving curved mirrors.
E12	Differentiate and identify convex and concave lenses.
E13	Understand the terms convex, concave, pole, principal axis, centre of curvature, focal points and focal length when applied to lenses.
E14	Explain how the refraction phenomenon responsible for the properties of lenses.
E15	Use the construction rules to draw ray diagrams to locate images through convex lenses.
E16	Draw ray diagrams and describe the 4 types of images possible with convex lenses.
E17	Use the construction rules to draw ray diagrams to locate images through concave lenses.
E18	Draw ray diagrams and describe the only type of images possible with concave lenses.
E19	Describe applications of convex and concave lenses.
C20	Use Descartes' formulae appropriately to solve problem involving lenses.
E21	Understand the meaning of the symbols used in Newton's formulae (S_o, S_i, m and f) for convex lenses.
C22	Use Newton's formulae appropriately to solve problem involving convex lenses.
E23	Understand the meaning of the symbols used in Newton's formulae (S_o, S_i, m and f) for concave lenses.
C24	Use Newton's formulae appropriately to solve problem involving concave lenses.

Waves – P2.3 Part 2

Student Learning Outcomes

At the end of the unit students can:

E1	Understand the following terms: wavelength, amplitude, velocity, frequency, period, wavefront and phase and solve simple problems involving these physical quantities.
C2	Understand and use appropriately the wave equation and discuss which wave properties are altered or not when changing media.
E3	Understand the difference between transverse and longitudinal waves **in terms of particle movement** and give examples of both types of wave.
E4	Describe the properties and the propagation of electromagnetic waves and sounds waves in details.
E5	Use the law of reflection appropriately, draw diagrams of images in one or more plane mirrors and describe the properties of the images.
E6	Draw diagrams for reflection of plane waves at plane and curved boundaries.
E7	Define refraction and describe the notations used.
C8	Explain the term refractive index and use the relationships between refractive index, speed and wavelength appropriately.
E9	Describe refraction when going from slow to fast medium and fast to slow medium for rays and plane waves with and without angle of incidence.
C10	Discuss the use of refractive index of a boundary for water waves going deep to shallow water and the speed of the waves in these two media.
E11	Explain with a diagram the apparent depth phenomenon.
C12	Use Snell's law appropriately, understand what is meant by critical angle and TIR and give examples of TIR.
E13	Define dispersion and explain this phenomenon.
E14	Define and describe interferences for pulses (or waves) on strings.
E15	Discuss and diagram how string pulses (or waves) are affected when reaching a fixed or a free end.
E16	Discuss and diagram how string pulses (or waves) are affected in thick-thin or thin-thick situations.
E17	Explain the creation of a standing wave by discussion of the 2 waves and superposition with correct terminology.
E18	Diagram and discuss diffraction of light, sound and water waves around barriers and gaps.
E19	Understand and discuss what causes the interference pattern when two waves interfere and use the terms nodes, antinodes, constructive interference and destructive interference appropriately.

Level 2 Physics Motion Unit Review
(Part 1 of 3: mechanics equations, graphs & projectiles)

Equations, NCEA language, key terms and common diagrams

KNOW THE EQUATIONS:

		Symbol's **complete** name And SI unit	Situation where equation is most commonly used (or notes about this equation). Use your own paper
$v = \frac{\Delta d}{\Delta t}$	v		
	Δd		
	Δt		
$a = \frac{\Delta v}{\Delta t}$	a		
	Δv		
$v_f = v_i + at$ $d = v_i t + \frac{1}{2} a t^2$ $d = \frac{v_i + v_f}{2} t$ $v_f^2 = v_i^2 + 2ad$	v_f		
	v_i		
	a		
	t		
	d		

Be familiar with the NCEA standard: what COULD be on the exam:

- constant acceleration in a straight line;
- free fall under gravity;
- projectile motion;

Know the MEANINGS & APPLICATIONS of the key-words or common terms

- displacement vs distance
- acceleration vs deceleration
- gradient of d-t graph
- gradient of v-t graph
- area of v-t graph
- constant velocity vs constant acceleration
- acceleration due to gravity
- free fall
- average velocity vs average speed
- instantaneous velocity
- resultant
- magnitude
- vector vs scalar
- linear
- kinematic equations of motion
- projectile
- air friction
- parabolic

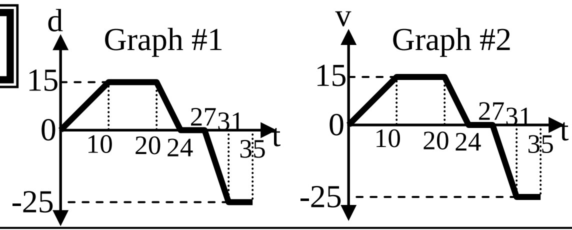
Optional (these will help with the force unit)

- relative velocity
- bearing
- components

Be familiar with the COMMON DIAGRAMS and GRAPHS in this unit:

(and know the details, labels, possible equations and *explanations* that accompany them)

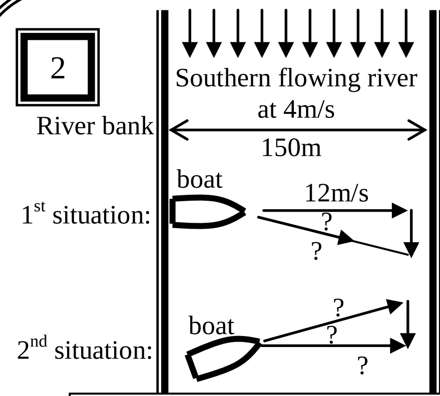
1



Calculate all possible values of importance and explain motion described in EACH graph.

Number 2 is optional

2



Calculate all possible values and describe EACH situation.

3

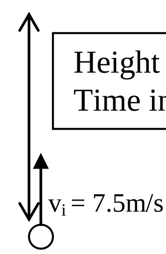
Draw a displacement-time graph AND a velocity-time graph for each of the following situations. Include any and all calculated values on each axis.

1st situation:
2.3kg cat falls from a 4.5m height.

2nd situation:
35g ball thrown straight up at 12m/s.

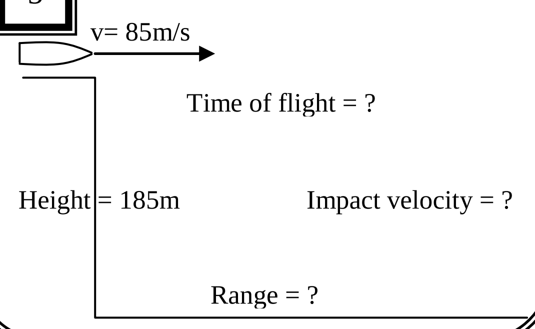
3rd situation:
13kg lead ball rolled up a ramp at 8m/s and the ramp causes deceleration of 0.5m/s^2.

4



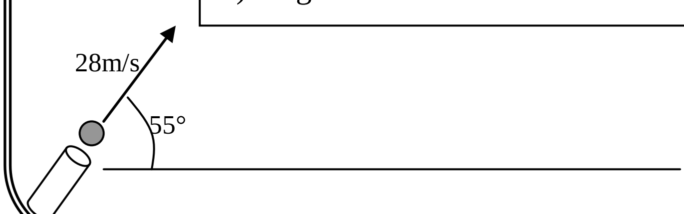
Height = ?
Time in air = ?

5



6

Calculate:
a) both components of initial velocity
b) time of flight
c) maximum height
d) range



Level 2 Physics Forces, Springs & Circles Unit Review

Equations, NCEA language, key terms and common diagrams

KNOW THE EQUATIONS:

		Symbol's **complete** name And SI unit	Situation where equation is most commonly used (or notes about this equation). Use your own paper
$F = -kx$	F		1
	k		
	x		
$F = mg$	m		2
	g		
$E_p = \frac{1}{2}kx^2$	E_P		3
$\Delta E_p = mg\Delta h$	ΔE_p		4
	h		
$F_c = \frac{mv^2}{r}$	F_C		5
	m		
	v		
	r		
$a_c = \frac{v^2}{r}$	a_c		6
$v = \frac{2\pi r}{T}$	T		7
$f = \frac{1}{T}$	f		8

Be familiar with the NCEA standard: what COULD be on the exam:

- Force components;
- vector addition of forces;
- unbalanced force and acceleration;
- equilibrium (balanced forces);
- centripetal force;
- force and extension of a spring;
- circular motion (constant speed with one force only providing centripetal force).

Know the MEANINGS & APPLICATIONS of the key-words or common terms

- components
- bearing
- resultant
- magnitude
- vector vs scalar
- equilibrium
- balanced vs unbalanced
- Hooke's Law
- elastic potential energy
- restorative force
- spring constant
- extension (or compression)
- area graph of restorative force vs extension
- work done by spring
- frequency
- period
- tangential velocity
- centripetal acceleration
- centripetal force
- constant speed while changing velocity

<u>Be familiar with the COMMON DIAGRAMS and GRAPHS in this unit:</u>

(and know the details, labels, possible equations and *<u>explanations</u>* that accompany them)

Use $g = 9.8 m/s^2$

1

F_1 = 45N at bearing of 045

F_2 = 35N at bearing of 315

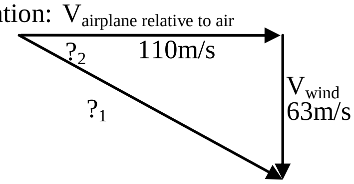
F_3 = 25N at bearing of 180

Draw scale diagrams and calculate the following values:
(a) $F_1 + F_2$
(b) $F_2 - F_3$
(c) $F_2 + F_1 + F_3$

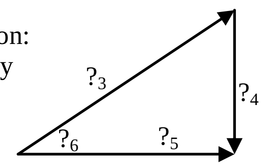
Optional Question

2

1st situation: $V_{\text{airplane relative to air}}$



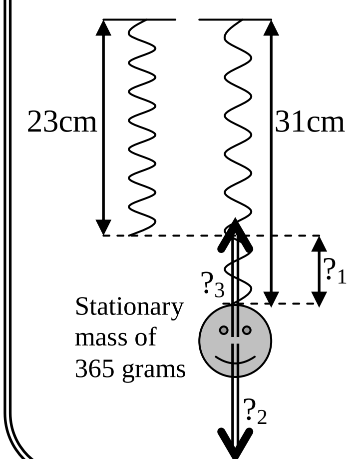
2nd situation: Commonly asked 2nd question



Name & calculate all possible values and describe EACH

3

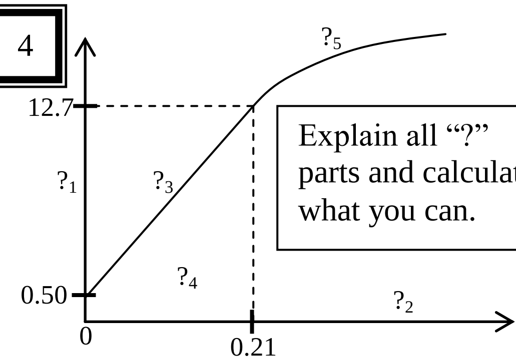
(a) Name and calculate all "?" parts



(b) Predict length of spring with an additional 135 gram added.

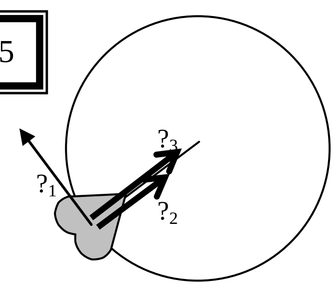
(c) What would happen if 2 identical springs were uses to hold the 365g mass?

4



Explain all "?" parts and calculate what you can.

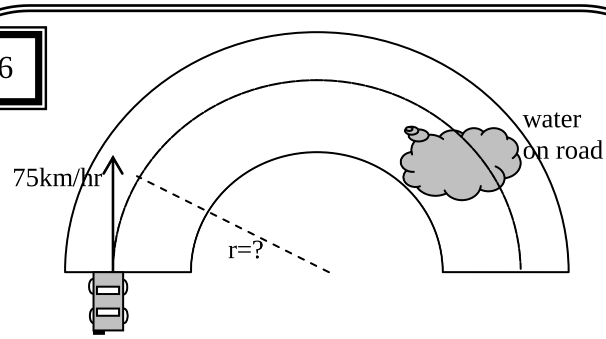
5



4.1kg mass makes 5.5 rotations in 12.7 s. Diameter of circle = 2.7m

(a) Name, describe and calculate all ? values & comment on magnitude of each. Assume constant speed.
(b) Draw diagram for Δv for any ¼ turn.

6



Person in car feels seatbelt pull them at 2.5 times their weight force. Total mass of car & driver = 1.56 tonnes.
(a) Calculate all unknown values: r, a_c, F_c & time to make 180° corner.
(b) Draw F_c and a_c at top of curve.
(c) Explain (with calculations) what happens if wheels can only grip road surface with 25kN on "wet patch" of road.

Level 2 Physics Energy, Momentum & Torque Unit Review

Equations, NCEA language, key terms and common diagrams

KNOW THE EQUATIONS:

		Symbol's **complete** name And SI unit	Situation where equation is most commonly used (or notes about this equation). Use your own paper
$E_k = \frac{1}{2}mv^2$	E_K		1
	m		
	v		
$\Delta E_p = mg\Delta h$	ΔE_P		2
	g		
	Δh		
$E_p = \frac{1}{2}kx^2$	E_P		3
	k		
	x		
$W = Fd$	W		4
	F		
	d		
$P = \frac{W}{t}$	P		5
	t		
$p = mv$	ρ		6
	m		
	v		
$\Delta p = F\Delta t$	Δρ		7
	F		
	Δt		
$\tau = Fd$	τ		8
	F		
	d		

Be familiar with the NCEA standard: what COULD be on the exam:

- Equilibrium (balanced forces and torques);
- Momentum;
- change in momentum in one dimension and impulse;
- impulse and force;
- conservation of momentum in one dimension;
- work
- power
- conservation of energy
- elastic potential energy

Know the MEANINGS & APPLICATIONS of the key-words or common terms

- Equilibrium (definition & both rules)
- Impulse
- Momentum
- Law of Conservation of Momentum
- Assumptions or conditions for law of conservation of momentum
- Law of Conservation of Energy
- Conversions of energy: EK, GPE, elastic, heat
- Torque
- Moment
- Fulcrum &/or Pivot
- Couple

OPTIONAL

- Elastic vs Inelastic Collision

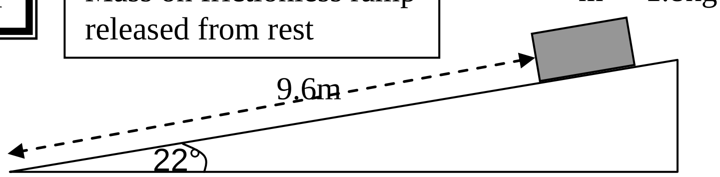
Be familiar with the COMMON DIAGRAMS and GRAPHS in this unit:

(and know the details, labels, possible equations and *explanations* that accompany them)

Use $g = 9.8 m/s^2$

1

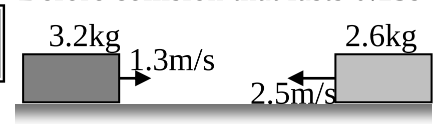
Mass on frictionless ramp released from rest



(a) Draw both "individual forces" and draw the net force on the mass when released.
(b) Calculate total energy and use this to calculate velocity of mass at bottom of ramp

2

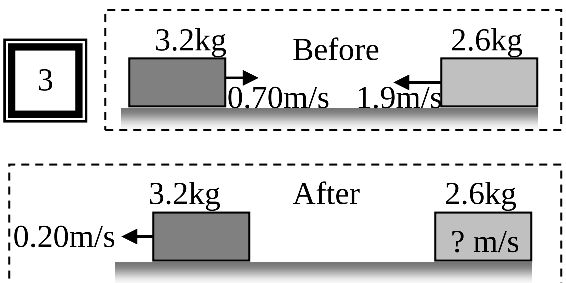
Before collision that lasts 0.13s



Blocks stick together after collision

(a) calculate velocity of blocks after collision
(b) calculate change in momentum of 2.6kg block
(c) calculate force involved in collision
(d) show by calculation if this is an elastic or inelastic collision

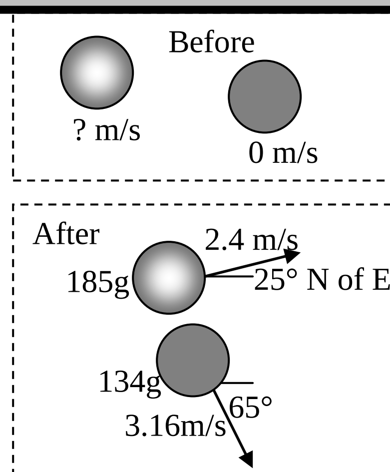
3



(a) calculate change in momentum of 3.2kg mass
(b) calculate velocity of 2.6kg mass after collision

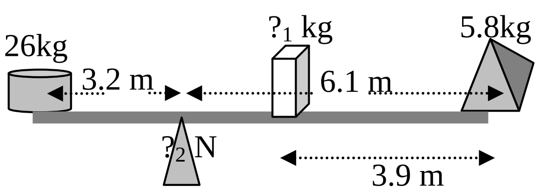
Number 4 is optional (2-D ρ)

4



(a) Draw vector diagram for total momentum
(b) Calculate velocity of 185g mass before collision
(c) Draw vector diagram for change in momentum of 185g mass (include all calculated values)

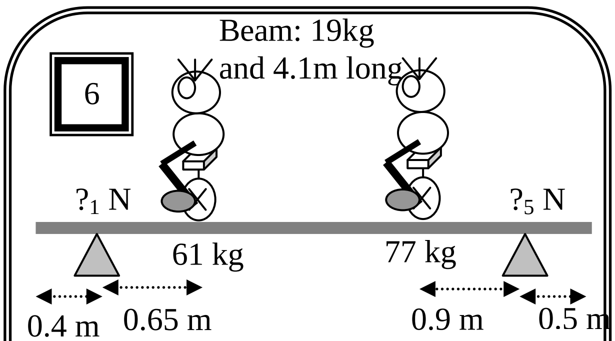
5



1. Assume beam has negligible mass:
   (a) Draw and label all forces involved
   (b) Calculate total anticlockwise torque
   (c) Calculate unknown mass ($?_1$)
   (d) Calculate unknown support force ($?_2$)

2. Repeat all 4 questions above with new diagram if the beam has a mass of 12kg!

6



1. Draw and label all 5 forces involved.
2. Find each support force ($?_1$ and $?_5$)

Year 12 Physics Electric Field & DC Circuits Unit Review

Equations, NCEA language, key terms and common diagrams

KNOW THE EQUATIONS:

Equation		Symbol's **complete** name And SI unit	Situation where equation is most commonly used (or notes about this equation). Use your own paper
$E = \frac{V}{d}$	E		1
	V		
	d		
$F = Eq$	F		2
	E		
	q		
$\Delta E_p = Eqd$	ΔE_p		3
	E		
	d		
$I = \frac{q}{t}$	I		4
	t		
$V = \frac{\Delta E}{q}$	V		5
	ΔE		
$V = IR$	V		6
	I		
	R		
$P = IV$	P		7
$P = \frac{\Delta E}{t}$	P		8
	ΔE		
$R_T = R_1 + R_2 + \ldots$	R_T		9
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	R_T		10

Be familiar with the NCEA standard: what COULD be on the exam:

- uniform electric field;
- electric field strength;
- force on a charge in an electric field;
- electric potential energy
- work done on a charge moving in an electric field
- DC parallel circuits with resistive component(s) in series with source,
- circuit diagrams;
- voltage, current, resistance, energy, power;

Know the MEANINGS & APPLICATIONS of the key-words or common terms

- Potential Difference or Voltage (definition)
- Current and Resistance
- Power
- Anode and/or Cathode
- Ohmic vs Non-ohmic Conductors
- Graphs of V vs I or graphs of I vs V
- Series vs Parallel Circuits
- Electric Field
- Cathode Ray Tube
- Electric Force on Charged Particles
- Work done on charge in electric field
- Millikan's Experiment
- Coulombs
- Coulombs per second
- Joules per Coulomb
- Joules per second
- Newtons per Coulomb
- Volts per Meter

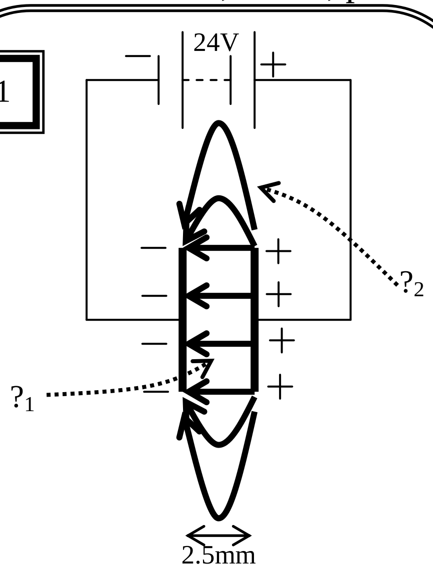
OPTIONAL:

- Thermistor vs LDR
- Diode or LED

Be familiar with the COMMON DIAGRAMS and GRAPHS in this unit:

(and know the details, labels, possible equations and *explanations* that accompany them)

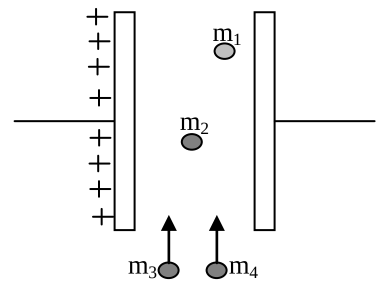
1



Calculate all possible values of importance and explain $?_1$ and $?_2$ and how arrows got created.

2

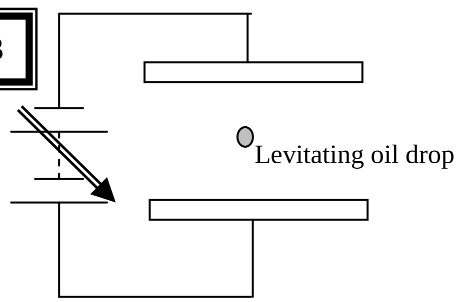
Capacitor connected to 12V source.
Plates are 2.3mm apart. $e = 1.6 \times 10^{-19}$C
Mass of proton = 1.6×10^{-27}kg
Mass of electron = 9.1×10^{-31}kg



m_1 has 3.4mC of charge and is 1/4th d from the negative plate.
m_2 has -2.7mC of charge and is ½ d from the negative plate.
m_3 is a proton and m_4 is an electron: both are moving straight up as they enter the capacitor gap.

a) Calculate the electric force on each mass (with direction)
b) Calculate the change in energy as each mass moves left or right.
c) Explain what happens to m_3 and m_4 as they enter the electric field. Calculate any possible values and draw a diagram showing their paths.

3

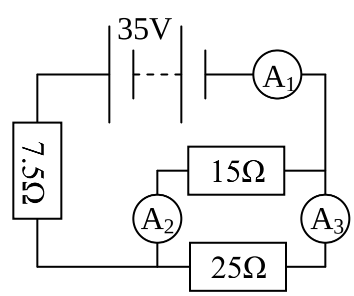


Power source setting = 45V   Plate separation = 3.5mm
Drop has mass of 2.3μg

a) Explain this situation or experiment.
b) Draw, name and give equation for both forces on drop to keep it stationary.
c) Calculate value of the weight force.
d) Calculate charge on drop.
e) Calculate number of missing or extra electrons on drop.

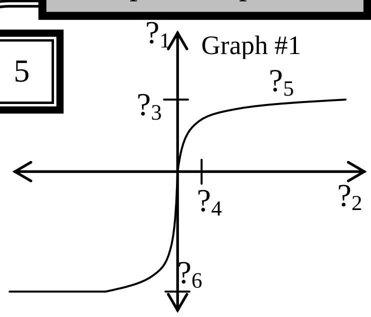
4

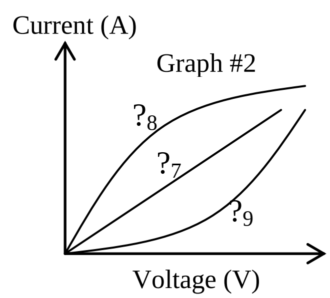
Calculate the values on the 3 ammeters **and** the voltage used by each resistor.



Graph 1 is optional

5



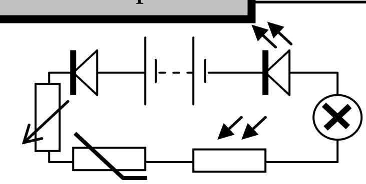


For graph #1: what is this about? Name all 6 parts and give values if possible.

For graph #2: note the given axis titles. What does the gradient of this graph mean? What could possibly make each of the 3 lines? Explain.

Number 6 is optional

6



Name each part in this circuit. Explain any important information regarding each part.

Year 12 Physics Magnetic Fields, Forces & Induced Voltage Unit Review

Equations, NCEA language, key terms and common diagrams

KNOW THE EQUATIONS:

Equation		Symbol's **complete** name And SI unit	Situation where equation is most commonly used (or notes about this equation). Use your own paper
$V = IR$	V		1
	I		
	R		
$P = IV$	P		2
	I		
	V		
$F = BIL$ or $F = BIL(\sin\theta)$	F		3
	B		
	I		
	L		
	θ		
$F = Bqv$	V		4
	q		
	v		
$V = BvL$	V		5
	v		
	L		

Be familiar with the NCEA standard: what COULD be on the exam:

- Force on a current carrying conductor in a magnetic field
- Force on charged particles moving in a magnetic field;
- induced voltage generated across a straight conductor moving in a uniform magnetic field;

Know the MEANINGS & APPLICATIONS of the key-words or common terms

- Potential Difference or Voltage
- Current and Resistance
- Elemental charge
- Power
- Anode and/or Cathode
- Magnetic Field
- "dot" and "x" symbols
- Circle and box symbols
- Lorentz Force (against motion)
- Right Hand Grip Rule
- Right Hand Slap Rule
- Motion of charges fired into magnetic fields
- Motion of charges inside conductors moving through magnetic fields
- Galvanometer

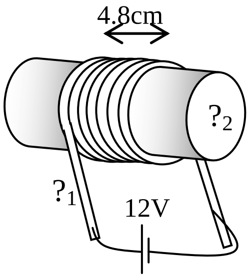
OPTIONAL:

- Motor (DC)
- Commutator
- Carbon Brushes
- Armature
- Turns
- Generator
- Extra formula: $B = \frac{\mu_o NI}{L}$ with $\mu_o = 1.26 \times 10^{-6}$

Be familiar with the COMMON DIAGRAMS and GRAPHS in this unit:

(and know the details, labels, possible equations and *explanations* that accompany them)

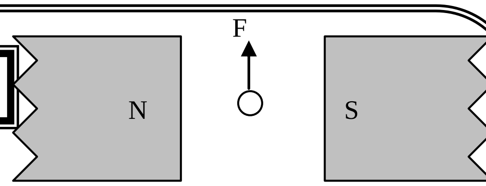
1



Wire's resistance = 1.45Ω

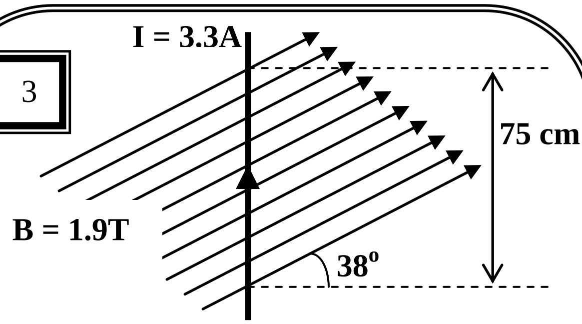
a) Calculate magnetic field inside solenoid.
b) Label poles of electromagnet
c) Draw magnetic fields inside electromagnet (& entering & exiting)
d) Explain various ways electromagnet could be made stronger AND why these work.

2



a) What direction must current be in wire to produce the given Lorentz Force?
b) Explain in detail how you worked out this direction of current.
c) Draw combined magnetic filed of current-carrying wire & existing magnet between the given N and S.
d) Calculate current if following values exist:
F = 2.45mN, B = 35.8mT, L = 48cm

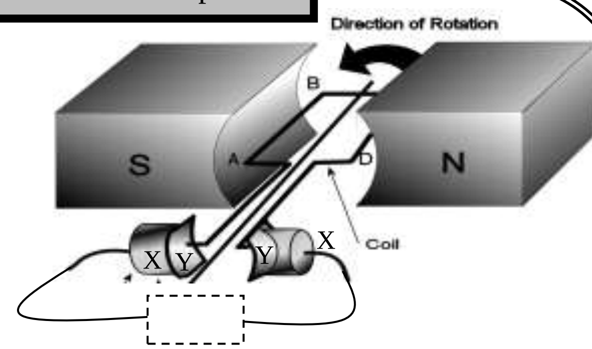
3



a) Calculate the magnitude of the Lorentz Force on the wire.
b) What is the direction of this force? Explain in detail how you work out the direction.
c) If the wire was rotated the following direction and degrees from its position in the diagram above explain how the Lorentz Force would change (give values):
   (i) wire rotated 38° W of N
   (ii) wire rotated 52° E of N

Number 4 is optional

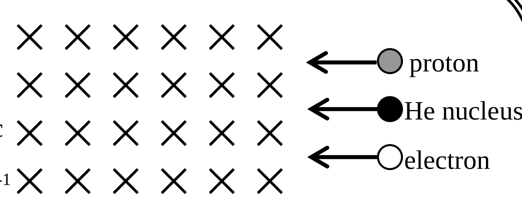
4



a) Given the direction of rotation in the diagram, draw the missing power source (DC).
b) Describe the two labelled parts of the circuit (X and Y).
c) If the distance from A to D was 14cm and A to B was 23cm, the current in the coil was 1.2A and the force on one side of the coil was 1.9mN calculate the magnetic field strength.
d) How would the coil work if there was 350 turns of wire with the same current and magnetic field that you just calculated?

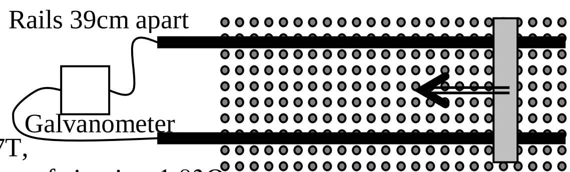
5

B = 2.95T
All v's = 75.0%c
$e = 1.60 \times 10^{-19}$C
$c = 3.00 \times 10^{8}ms^{-1}$



a) Complete the diagram above showing the path of all 3 particles.
b) Calculate the Lorentz Force on each particle while the particle is inside the magnetic field.
c) Explain in detail how you worked out these 3 paths. Compare and contrast all 3 particles' forces and paths.

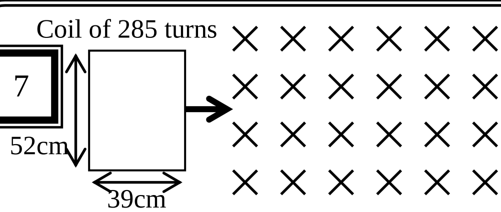
6



B = 2.97T,
Resistance of circuit = 1.83Ω
Rod pulled left at 85cm/s

a) Draw needle in galvanometer showing direction of current.
b) Calculate size of current.
c) Explain in extreme detail how voltage is produced.

7



B = 3.9T
v = 3.75m/s
R_{coil} = 26.3Ω
Assume velocity is constant

a) Calculate current as coil enters magnetic field.
b) Redraw diagram when coil has ½ entered B-field and show direction of current.
c) Explain what happens (in extreme detail) as
   (i) coil enters, (ii) passes through and (iii) exits magnetic field.
d) If coil was stationary in the middle of this B-field, how could voltage be induced without moving coil up, down, left or right?

Year 12 Physics Refraction, Diffraction & Interference of Waves

equations, NCEA language, key terms and common diagrams

KNOW THE EQUATIONS:

Equation		Symbol's **complete** name And SI unit	Situation where equation is most commonly used (or notes about this equation). Use your own paper
$n_1 \sin\theta_1 = n_2 \sin\theta_2$	n_1		1.
	θ_1		
	n_2		
	θ_2		
${}_1n_2 = \frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$	${}_1n_2$		2.
	$v_{1 \text{ or } 2}$		
	$\lambda_{1 \text{ or } 2}$		
	$n_{1 \text{ or } 2}$		
$f = \frac{1}{T}$	f		3.
	T		
$v = f\lambda$	v		4.
	f		
	λ		

Be familiar with the NCEA standard: what COULD BE on the exam:

- refraction,
- total internal reflection & critical angle at a plane boundary,
- superposition of pulses,
- diffraction through a slit,
- reflection & refraction at a plane boundary including phase & wave parameter changes if applicable,
- 2-point source interference (qualitative),

Know the MEANINGS & APPLICATIONS of the key-words or common terms

1. longitudinal
2. transverse
3. wavelength
4. frequency
5. reflection
6. refraction
7. normal
8. index of refraction
9. refractive index
10. Deep vs Shallow waves
11. critical angle
12. total internal reflection
13. diffraction through gap/slit
14. superposition (waves or pulses) or standing wave
15. constructive interference
16. destructive interference
17. antinodes
18. nodes
19. in phase vs out of phase
20. standing wave
21. diffraction grating
22. Young's Double Slit
23. fringes
24. path difference

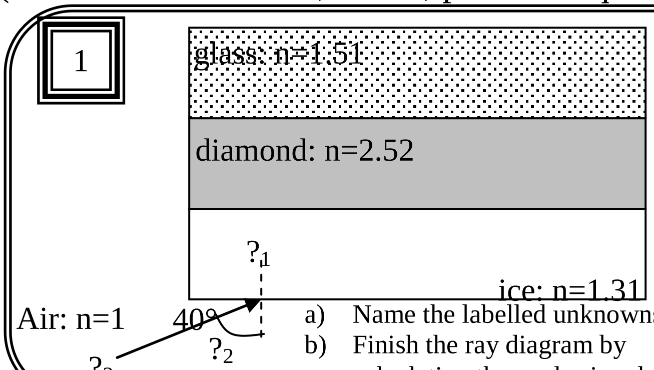
Optional:

25. diffraction around corner
26. diffraction around island

Be familiar with the COMMON DIAGRAMS and GRAPHS in this unit:

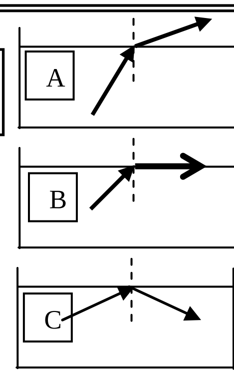
(and know the details, labels, possible equations and *explanations* that accompany them)

1



a) Name the labelled unknowns.
b) Finish the ray diagram by calculating the angles involved

2

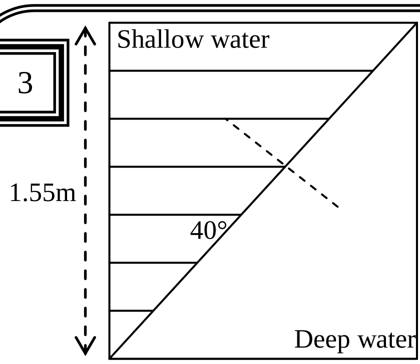


Explain the sequence of diagrams A, B and C.

Assume the rays are for a light wave.

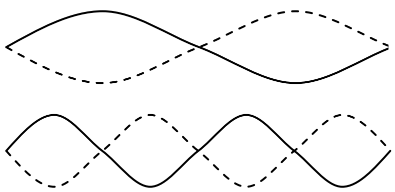
Include how the wave changes (or not) after it hits the boundary between the 2 media.

3



a) Draw an arrow showing the velocity of the waves in the shallow section to the given normal.
b) What is the angle of incidence?
c) Draw the wave fronts in the deep section.
d) If the refractive index from deep to shallow is 1.22, what is the refractive index from shallow to deep?
e) Calculate the wavelength and angle of refraction in the deep section.

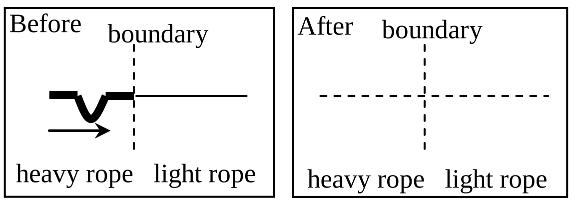
5



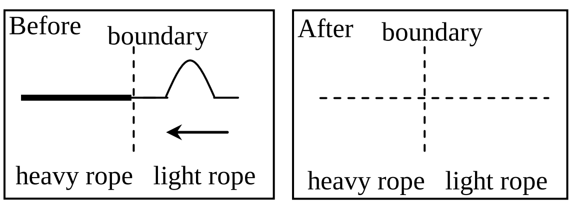
a) Explain how these waves in strings are created.
b) Add to the diagrams by labelling important parts and explain these parts.
c) Explain how the 2nd diagram could be made if both diagrams are the same string.

6

A

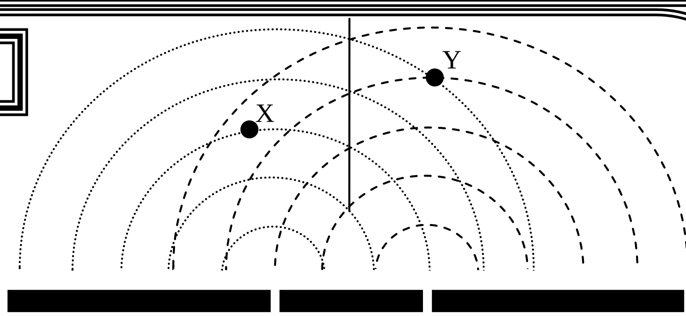


B



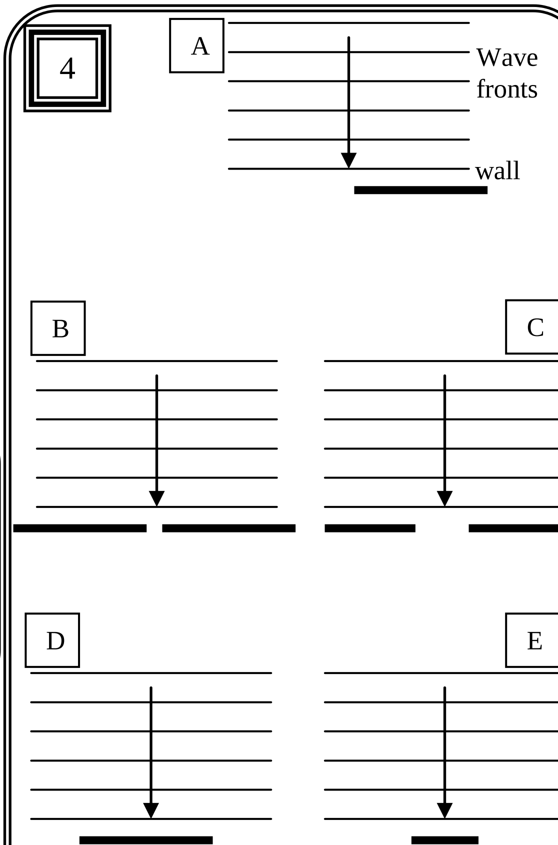
a) Complete both diagrams (A & B) and explain how each part of each answer is the same or different from the incident pulse.
b) Draw the 2 possible diagrams for an incident pulse on a single rope where the rope is tied or not tied to an object.

7



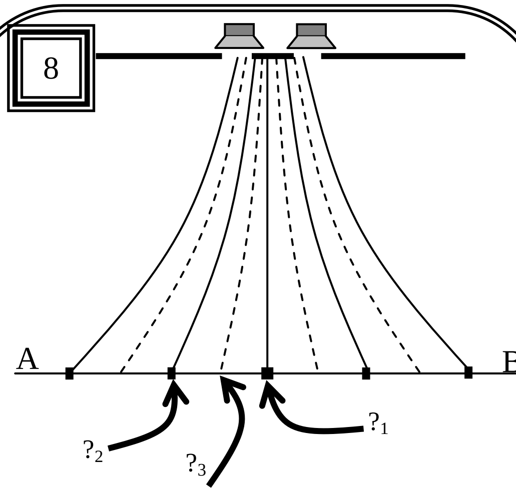
Assume the situation is for water waves seen from above.
a) Draw the wave fronts below the barrier. Include at least 3 wave fronts.
b) Explain what the 2 sets of dotted lines represent above the barrier and how they are created.
c) Explain what a person would see at X and Y. Use the physics principles to explain why.

4



a) Name and define the principle involved in all 5 diagrams.
b) Complete all 5 diagrams: draw at least 4 wave fronts after the wall and at least 2 more arrows showing how velocity is the same or changed.
c) Explain how and why B and C (and how D and E) are different.

8



Assume the situation is for sound.
Explain what the solid and dotted lines represent and how they are created.
Explain how a person would experience walking from A to B. Include the 3 labelled locations specifically.

Year 12 Physics Convex & Concave Mirrors & Lenses Unit Review

equations, NCEA language, key terms and common diagrams

KNOW THE EQUATIONS:

Equation		Symbol's **complete** name And SI unit	Situation where equation is most commonly used (or notes about this equation). Use your own paper
$\frac{1}{f}=\frac{1}{d_o}+\frac{1}{d_i}$	f		1.
	d_o		
	d_i		
$m=\frac{d_i}{d_o}=\frac{h_i}{h_o}=\frac{f}{S_0}=\frac{S_i}{f}$	m		2.
	h_i		
	h_o		
	S_o		
	S_i		

Be familiar with the NCEA standard: what COULD BE on the exam:

- Reflection in curved mirrors,
- Refraction through lenses,

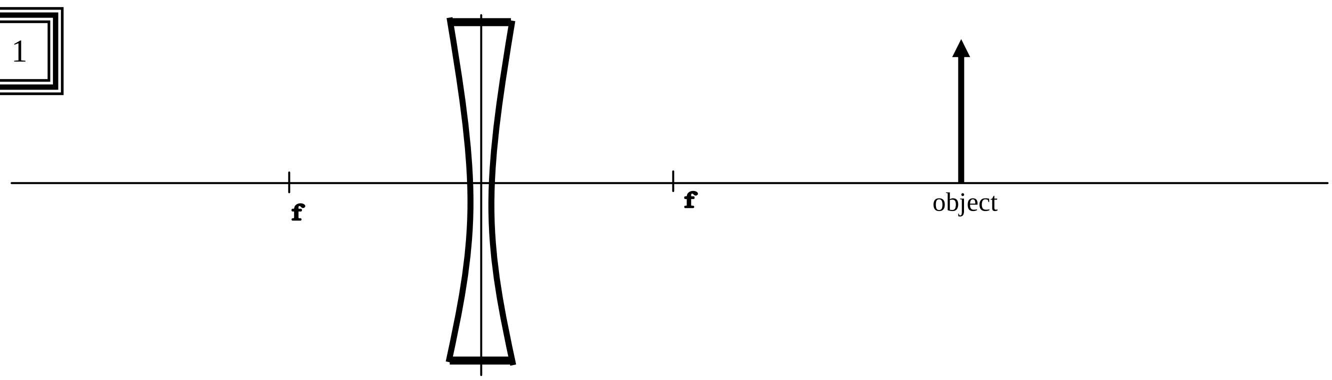
Know the MEANINGS & APPLICATIONS of the key-words or common terms

27. convex
28. concave
29. diverging
30. converging
31. centre of curvature
32. focal (or focus) point
33. principle axis
34. nature of image
35. virtual
36. real
37. magnified or enlarged
38. diminished
39. inverted
40. upright
41. refraction
42. reflection
43. "near focus"
44. "far focus"
45. uses of convex mirror
46. uses of concave mirror
47. uses of convex lens
48. uses of concave lens

Be familiar with the COMMON DIAGRAMS and GRAPHS in this unit:

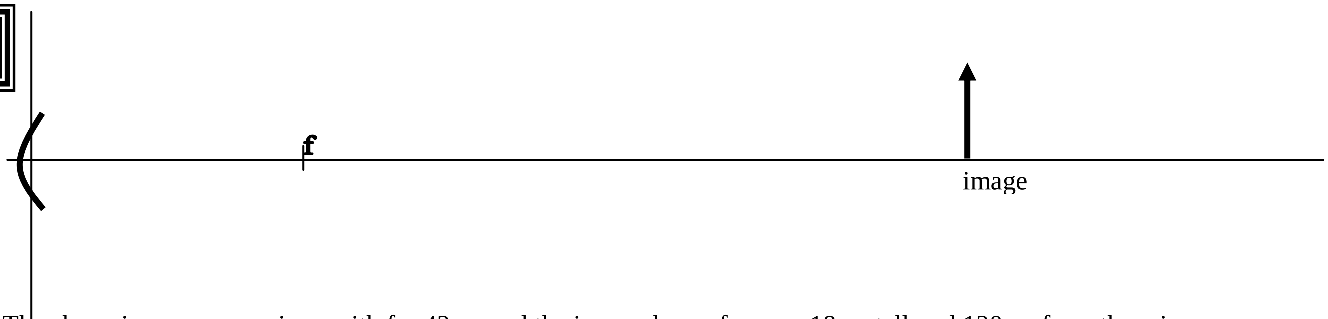
(and know the details, labels, possible equations and *explanations* that accompany them)

1



c) Name the type of lens (give both names).
d) Draw THREE light rays from the tip of the object and find the location of the image.
e) If c = 45cm, do = 50cm and ho = 15cm calculate the following: di, m, Si, So.
f) Draw double arrows in the diagram to show the following: do, di, So, Si
g) Explain the nature of the image.
h) If the object was moved farther away, what (specifically) would happen to the image? Be thorough in your answer.

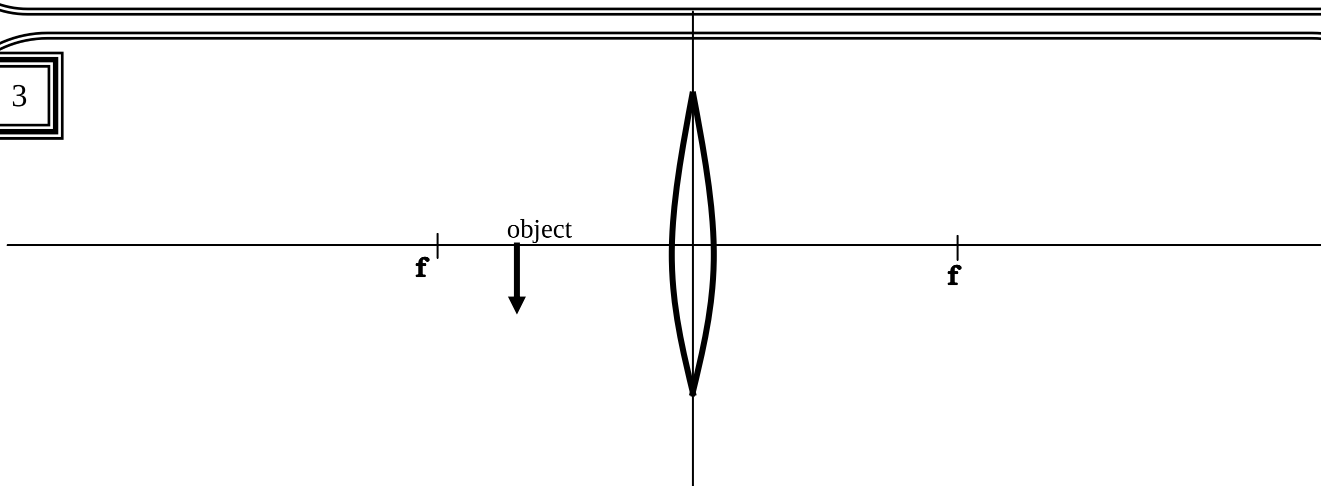
2



The above is a concave mirror with f = 42cm and the image drawn for you. 18cm tall and 120cm from the mirror.

a) Use "reverse-logic" to work out the location of the object using THREE light rays.
b) Calculate the following: do, m, So, Si.
c) Draw double arrows in the diagram to show the following: do, di, So, Si
d) If the object was moved just a bit to the left, where would the image move and how else would the image change?
e) If the object moved "more than a bit" to the left, what would happen?

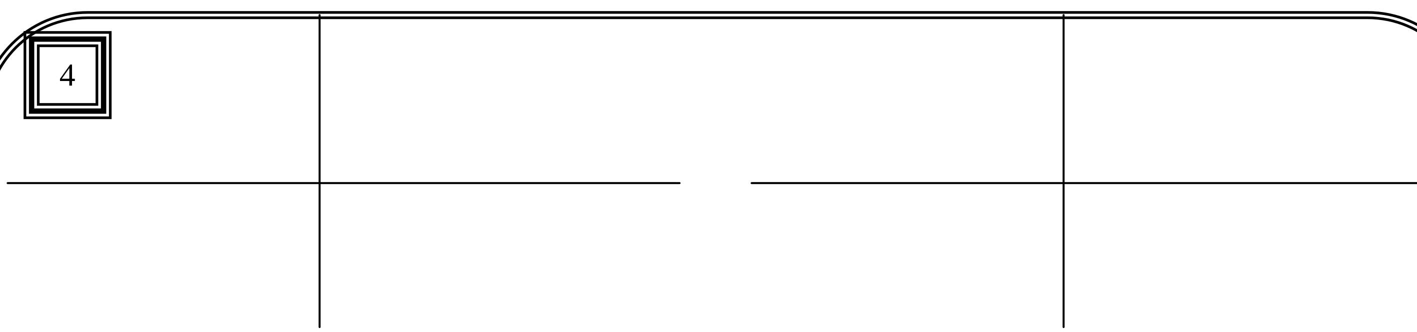
3



The object is 8.5cm tall and 6cm from the near focal point. The centre of curvature is 36cm.

a) Using THREE ray work out the location of the image.
b) Calculate the following: do, di, m, So, Si.
c) Draw double arrows in the diagram to show the following: do, di, So, Si
d) If the object was moved just a bit to the right, where would the image move and how else would the image change?
e) If the object moved exactly 6cm to the left, what would happen?
f) Where would the object need to be for the image to be 8.5cm tall?

4



Each vertical line represents a curved mirror with centre of curvature of 16cm. Each mirror makes an image 5cm behind the mirror. Each type of curved mirror is capable of making this image.

a) For the convex mirror: calculate the following: do, m, So, Si.
b) For the concave mirror: calculate the following: do, m, So, Si.
c) For each principle axis & vertical line draw a ray diagram that fits each situation (1 diagram for convex mirror & 1 diagram fro concave mirror).
d) For each mirror: if the object was moved just a bit farther from the mirror, where would the image move and how else would the image change?
e) For each mirror: where would the object need to be to create an image of exactly the same height?

Pulse Superposition & Thick-Thin Pulses Revision Questions

$n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\quad {}_1n_2 = \frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$ $\quad v = f\lambda$ $\quad f = \frac{1}{T}$

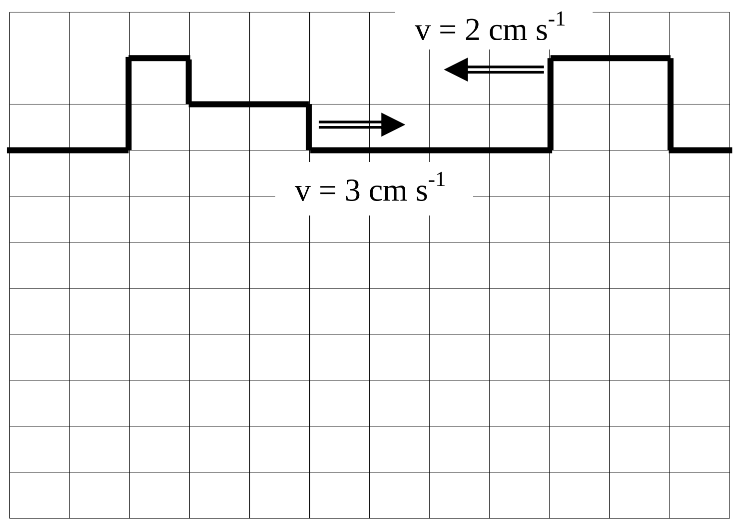
speed of light in vacuume = 3.00 x 10^{-8} ms^{-1} speed of sound in air is $330ms^{-1}$

QUESTION ONE: fun with water tanks

(a) While doing the investigation in a water tank making waves and watching what happens, David observes an interference pattern set up in the tank when waves reflect off the walls of the tank. Explain fully what is meant by the phrase ‘interference pattern’.

David uses a computer program to investigate interference of waves by sending two pulses of the shapes shown towards each other, at the speeds shown.

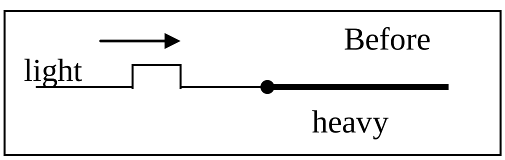
(b) On the empty grid space below the two pulses, draw the shape and position of the superimposing pulses 1s later than the time shown.



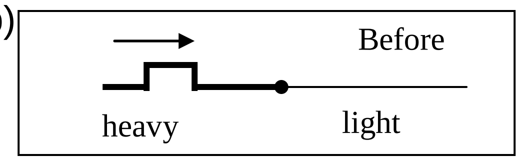
QUESTION TWO: Rope

For the following diagrams sketch the reflected and transmitted pulses.Show clearly their direction of travel with arrows and also any phase changes that have occurred. Draw the “after” diagram for each:

(a)

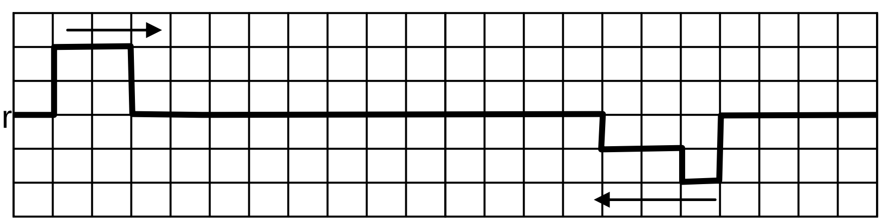


(b)

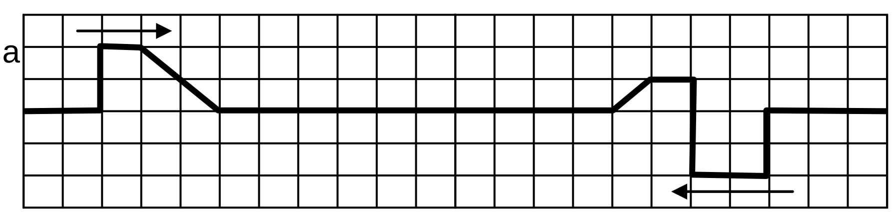


QUESTION THREE: more pulses

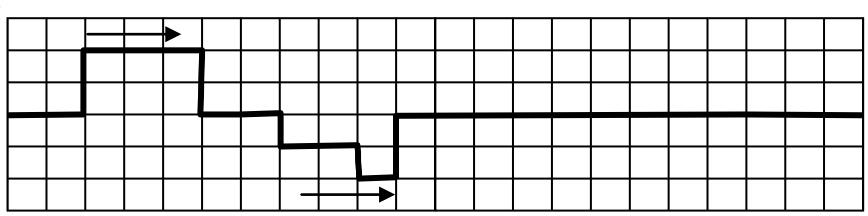
(a) The two pulses to the right are approaching each other at a speed of one square per second. Draw their superposition after 7 seconds have elapsed.



(b) The second set of two pulses to the right are approaching each other at a speed of 2 squares per second. Draw the superposition after 3 seconds have elapsed.



(c) The third set of two pulses below are moving in the same direction. The left hand one is travelling at 5 squares per second and the right hand one at 2 squares per second. Draw the superposition after 2 seconds.



QUESTION FOUR: fill-in the blanks

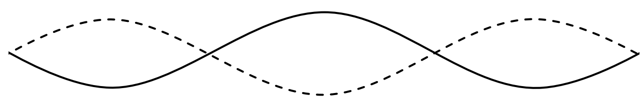
Use the following words to fill-in the blanks:

nodes, antinodes, maximum, opposite, reflected, standing, displacement

A standing wave is produced as a wave travels through a medium and is ________________ back on itself. The interference between the original wave and its reflection as they travel in __________________ directions can produce a new waveform called a _________________ wave. A standing wave is characterised by constant positions of no _______________ where the two waves cancel each other out. These positions are called ________________. In between these nodes there are positions where the displacement of the medium is ____________________. These positions of maximum displacement are called _____________________.

QUESTION FIVE: standing waves

(a) Label the nodes and antinodes on the standing wave shown to the right. Also identify one wavelength.



(b) A standing wave is set up in a taut string. The string is vibrated at a frequency of 350 Hz. The string is 1 m long and a total of 6 antinodes are counted along its length.

(i) What is the wavelength of the standing wave?

(ii) What is the speed of the wave in the string?

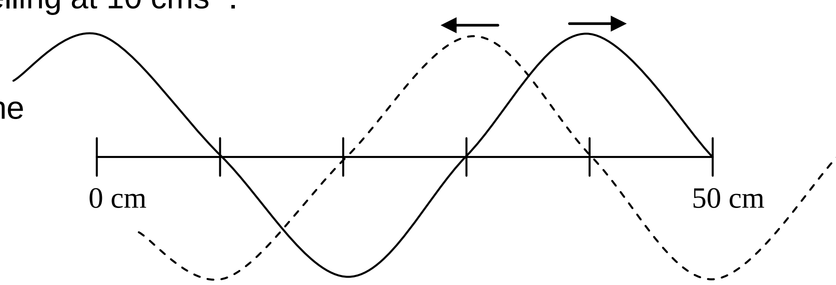
(c) Many musical instruments work by producing standing waves in strings, wires or air columns.

(i) Name one instrument that uses vibrating wires to produce sound.

(ii) Name an instrument that uses vibrations in an air column to produce sound.

(d) The two waves shown below are interfering on the same string to produce a standing wave. At the instant shown, both waves are travelling at 10 cms^{-1}.

How much time will elapse before the string is showing zero displacement over its whole length?



Mirrors & Lenses AND Refraction Revision Questions

$$\frac{1}{f}=\frac{1}{d_o}+\frac{1}{d_i} \quad \text{or} \quad s_i s_o = f^2 \qquad m=\frac{d_i}{d_o}=\frac{h_i}{h_o} \quad \text{or} \quad m=\frac{f}{s_o}=\frac{s_i}{f} \qquad f=\frac{1}{T} \qquad {}_1n_2=\frac{\sin\theta_1}{\sin\theta_2}=\frac{v_1}{v_2}=\frac{\lambda_1}{\lambda_2}=\frac{n_2}{n_1}$$

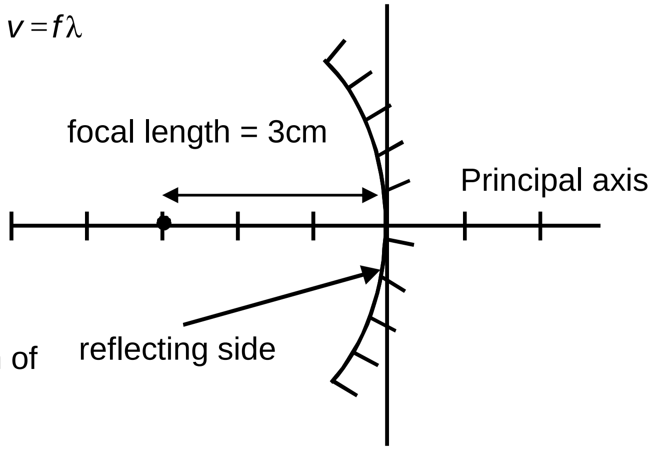
$$n_1\sin\theta_1 = n_2\sin\theta_2 \qquad v=f\lambda$$

QUESTION ONE: Torches and Lenses

Torches use concave mirrors to maximise the brightness of the beam of light they emit. The focal length of a concave mirror in a torch light is 3.0 cm.

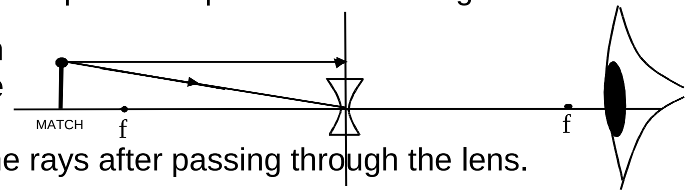
(a) Calculate the position of the centre of curvature of the mirror.

(b) On the diagram, use the letter B, to show where the light bulb should be placed to provide a parallel beam of light.



(c) Explain why the position for the bulb you chose will provide a parallel beam of light.

Jane uses a concave lens to see a match as shown in the diagram. Two light rays coming from the top of the match are shown on the diagram.



(d) On the above diagram complete the paths of the rays after passing through the lens.

(e) On the same diagram show how and where these rays will create the image of the match stick. Draw the image of the match.

(f) Describe two properties of the image of the match.

Jane now moves the match to a distance of 4.1 m from the lens. The focal length is 0.42 m.

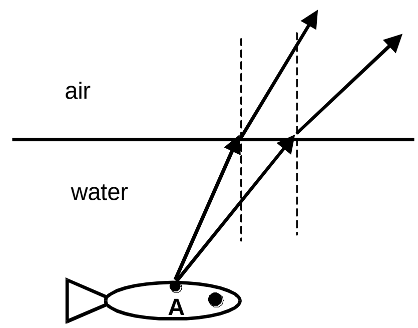
(g) Calculate the distance of the image from the lens.

(h) Calculate the magnification of the image.

(i) Calculate how far the match needs to be placed from the lens to obtain a virtual image half the size of the match.

QUESTION TWO: spear fishing

Jack attempts to catch a fish by throwing a spear at where the fish appears to be in the water. The following diagram shows two light rays travelling from the fish to the air above the water.



(a) Complete the above ray diagram to show the position of the image of the fish as seen by Jack.

(b) Explain why Jack will see the point A on the fish at a different place to where it actually is in the water.

Jack notices that the wavelength of water waves in the river increases as they move from a shallow region to a deeper region of water.

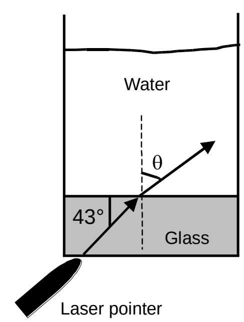
(c) Explain why the wavelength of the water waves increases as they move from a shallow region to a deeper region of water.

In the shallow region the frequency of the waves is 2.20 Hz and the wavelength of the waves is 0.21 m.

(d) Calculate the velocity of the waves. Give your answer to the correct number of significant figures.

QUESTION THREE: Laser pointer

A fine beam of red laser is shone from a laser pointer onto the bottom of a thick-bottomed glass with some water in it as shown in the diagram. The light is incident on the glass-water interface at 43°, as shown below. The refractive index of glass is 1.51 and that of water is 1.33.



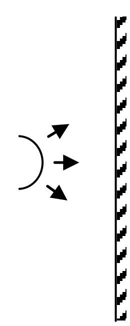
(a) Calculate that the angle of refraction, θ.

(b) Calculate the critical angle for the glass-water boundary.

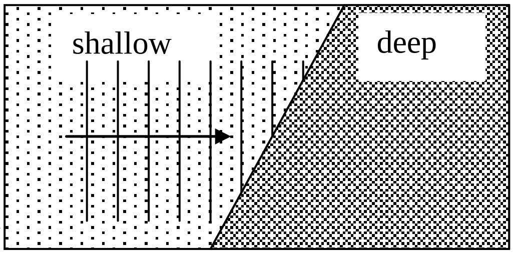
(c) The speed of red laser light in water is 2.26×10^{8} ms^{-1} and its frequency is 5.64×10^{14} Hz. Calculate the wavelength of the red laser light in glass.

QUESTION FOUR:

(a) A circular wave-front approaches a plane reflecting surface as shown. Draw the shape of the reflected wave-front some time later.



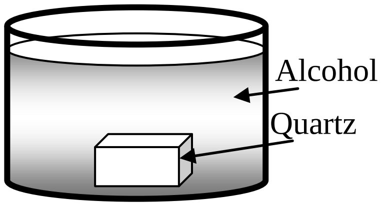
A wave-train is travelling through water in a shallow pool and passes into a deeper region as shown.



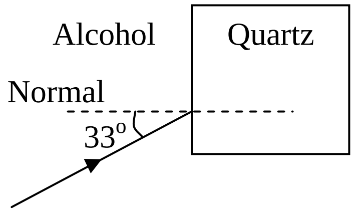
(b) On the diagram sketch the waves as they travel through the deep region.

(c) Explain how the change in wavelength is produced.

(d) The wave speed in the shallow region is 0.75ms^{-1}, and the relative refractive index of the boundary between the shallow and deep water is 0.80.
Calculate the speed of the waves in the deep water.



QUESTION FIVE: A cube of polished quartz is immersed in a container of alcohol as shown in the diagram.The absolute refractive indices are: quartz (1.54), alcohol (1.36)A ray of light is shone into the container of alcohol so that it strikes one face of the quartz cube at an angle of incidence of 33^o as shown.



(a) Calculate the angle of refraction of the ray as it passes into the quartz cube.

(b) On the diagram, sketch the path of the ray as it goes through the quartz and out into the alcohol again. Draw the second normal and clearly label the size of the angles of incidence and refraction at the quartz-alcohol interface.

(c) If light travels at 3.0 x 10^8 ms^{-1} in a vacuum, calculate the speed of light in alcohol.

(d) Describe the two conditions necessary for the occurrence of total internal reflection as light passes from one medium to another.

(e) Calculate the Critical Angle for light passing from quartz to alcohol.

(f) A boy is swimming under water next to a boat and looks up through the water at the green navigation light on the boat. The boy is not wearing any goggles (goggles are underwater swimming glasses). The rays of green light from the boat slow down as they pass into the water. Assuming that colour is a sensation produced by the interaction of light with the retina at the back of the eye, comment on whether you think the boy would still see the light as its normal green colour. Explain your answer giving reasons.

Diffraction & Interference Revision Questions

$n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\quad$ ${}_1n_2 = \frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$ $\quad$ $v = f\lambda$ $\quad$ $f = \frac{1}{T}$

speed of light in vacuume = 3.00 x 10^{-8} ms^{-1} speed of sound in air is 330ms^{-1}

QUESTION ONE: Fireworks Display

Malcolm and Rona watch a fireworks display on their trip to Wellington. As each rocket explodes a flash is seen and a low pitched bang is heard.

(a) Which of these is experienced first by Malcolm and Rona?

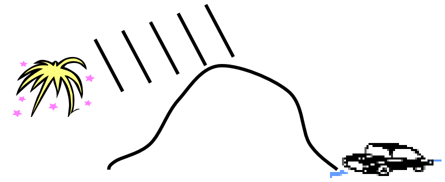
(b) Describe two important differences between sound and light waves.

The time difference between the bang and the flash is 3.0 seconds.

(c) Calculate how far away they are from the exploding fireworks.

(d) Calculate the wavelength of the sound heard if the frequency is 160Hz.

(e) Calculate the Period of the sound waves.



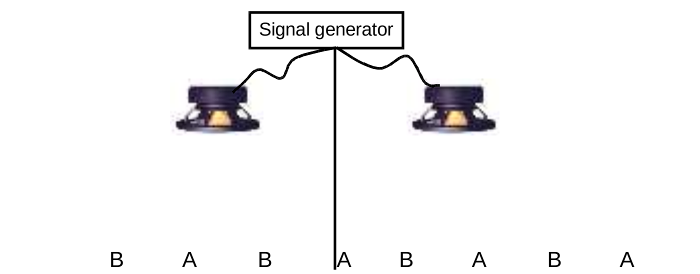
Hal is stuck in traffic with a hill between him and the fireworks display.
(f) Name the phenomenon that allows him to hear the bangs.

(g) Explain why he can hear but not see the fireworks display.

QUESTION TWO: Finding Peace
Malcolm prefers to watch the fireworks show without the sound of the explosions so he has made a silence machine that uses interference to cancel the noise. The silence machine is comprised of a microphone, a processor and a large loudspeaker.
(a) Explain how this machine can cancel the sound of the explosions. You may want to draw a diagram.

The display features a section where two identical rockets are exploded simultaneously. Malcolm's brother Dewey finds that by walking around he can find quiet spots. He needs no silence machine.
(b) Explain why there are louder and quieter places when two rockets explode simultaneously.

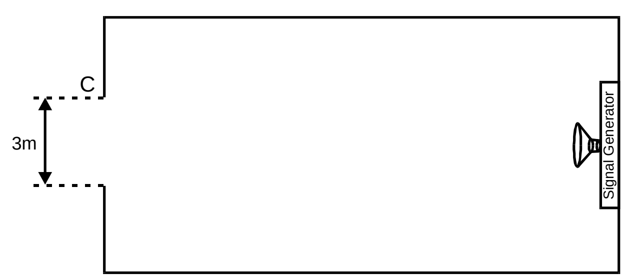
QUESTION THREE: Sound Waves
Susan and Maatai are investigating the behaviour of sound waves. They place two identical speakers some distance apart. They then connect them to a signal generator to produce sound waves that are in phase and of the same frequency.



Maatai now walks across the floor in front of the loudspeakers and he notices that the intensity of the sound repeatedly increases and decreases.
(a) State the name of the phenomenon.

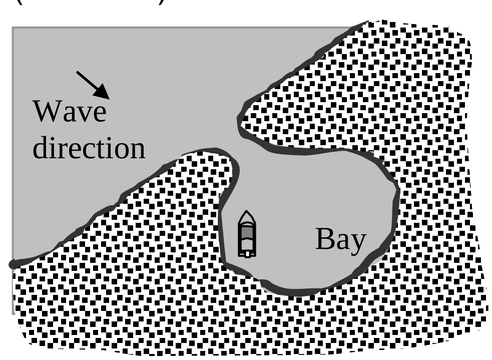
(b) Explain why the intensity of the sound changes.

Maati disconnects one speaker and asks Susan to stand outside the hall at C near the open doorway while the other speaker is still operating.
(c) Calculate the wavelength of the waves produced by the speaker in the air given that the period of the speaker cone is 5.0×10^{-4} s.



He now changes the frequency from 1000 Hz (λ = 0. 33 m) to 100 Hz (λ = 3.3 m). Susan hears the sound because of the diffraction of the sound waves.
(d) State which frequency diffracts the most and explain why.

QUESTION FOUR: Safe Harbour
Bill shelters during some rough weather by mooring his boat in a small bay which has a 20 m wide entrance as shown below.

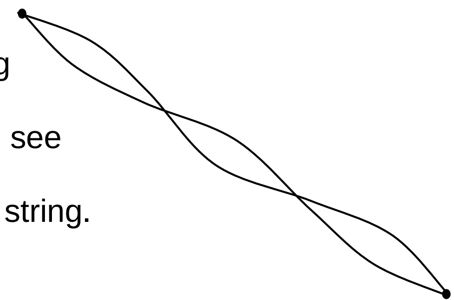


As Bill stays on his boat in the bay for a few days he notices that some waves still reach him and make his boat rock. All the time he is there the waves are coming in parallel to the shore line and he notices that the amount of rocking depends on the wavelengths of the waves entering the bay more than on their height.

(a) What is the name of the effect that is causing Bill's boat to be affected by some waves even when it is sheltered around the corner of the headland as shown.

(b) On the diagram sketch some 5 m wavelength waves approaching and entering the bay.
Will these waves affect the boat very much? Explain your answer.

(c) After the weather improves, Bill leaves the bay and anchors out from the shoreline to do some fishing. As he is fishing he notices that 9 small waves pass under the boat every minute. The wavelength of the waves is the same as the length of his boat which is 4.2 m. Calculate the frequency of the waves.



(d) As the breeze blows through the boat Bill hears a sound being produced by a stretched piece of string which is holding the canopy down at the back. The string is 1.5 m long and he can see nodes and antinodes along its length as shown below.

(i) Label the nodes (N) and antinodes (A) on the vibrating string.

(ii) Calculate the wavelength of the standing wave.

(e) When two waves travel through the same medium they can interfere with one another and produce patterns of nodes and antinodes. Name the type of interference that produces nodes.

Linear Mechanics AND Energy Revision Questions

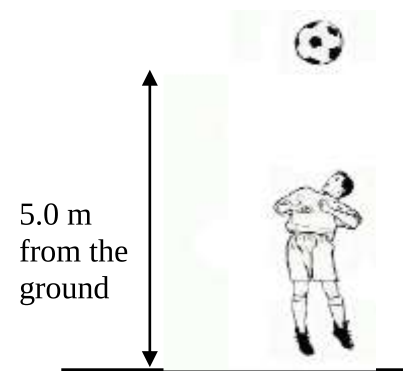
$v = \frac{\Delta d}{\Delta t}$ $\quad a = \frac{\Delta v}{\Delta t}$ $\quad v_f = v_i + at$ $\quad d = v_i t + \frac{1}{2}at^2$ $\quad d = \frac{v_i + v_f}{2}t$ $\quad v_f^2 = v_i^2 + 2ad$

$F = ma$ $\quad p = mv$ $\quad \Delta p = F\Delta t$ $\quad E_k = \frac{1}{2}mv^2$ $\quad \Delta E_p = mg\Delta h$ $\quad W = Fd$ $\quad P = \frac{W}{t}$

Acceleration due to gravity = $10 ms^{-2}$

QUESTION ONE: soccer game

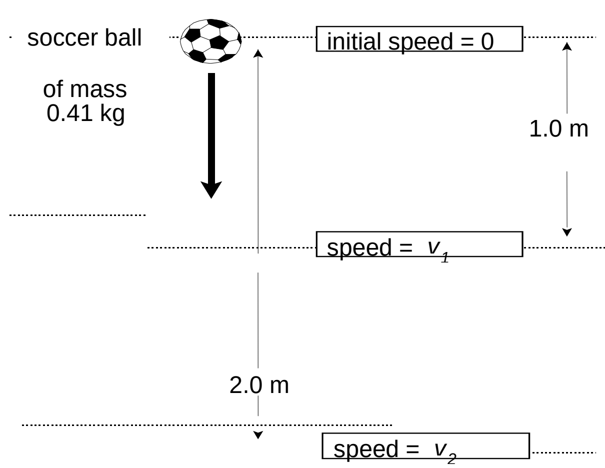
During a soccer game, the ball is headed straight up in the air. It reaches a height of 5.0 m as shown in the diagram and it then falls to the ground. The mass of the ball is 0.41 kg.



(a) Show that the gravitational potential energy of the soccer ball when it is at 5.0 m from the ground is 20.5 J.

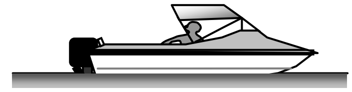
(b) Calculate the velocity of the ball just before it hits the ground.

(c) Give a clear explanation of the physical principle used to solve the problem (b). State any assumptions that you have made.



(d) The speed of the soccer ball after falling the distance of 1.0 m is v_1 and the speed of the soccer ball after falling the distance of 2.0m is v_2 , as shown in the diagram.
Determine a numerical value for the ratio of the speeds $\frac{v_2}{v_1}$.

QUESTION TWO: Boating



A family on holiday launch a boat from the boat ramp in Lake Taupo where there is no current.

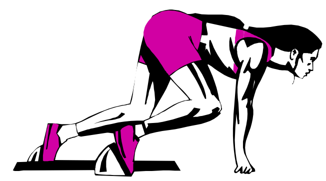
(a) As they are moving away from the boat ramp they travel at a steady speed of 1.4 ms^{-1}. Once they pass the 200m marker they accelerate uniformly for 5.5 seconds reaching a speed of 10ms^{-1}. Show that the acceleration of the boat is 1.6 ms^{-2}.

(b) Show that the distance travelled by the boat during the 5.5s it is accelerating is 32m.

(c) The mass of the boat and its passengers is 1080 kg. Calculate the work done by the engine in accelerating the boat. Express your answer to the correct number of significant figures using standard form notation.

(d) In fact, the engine does more work than the value calculated in (c). Comment on the reasons why.

QUESTION THREE: The 100m sprint



Mary is at the start of her 100m sprint race. She is at rest and, at the firing of the starting gun; she accelerates for 4.0s up to her sprinting speed. She travels 19.2 m while accelerating.

(a) Calculate Mary's acceleration.

(b) Calculate the speed Mary attains after these first 4.0 seconds.

Mary runs the rest of the race at a constant velocity and records a time of 12.8s.

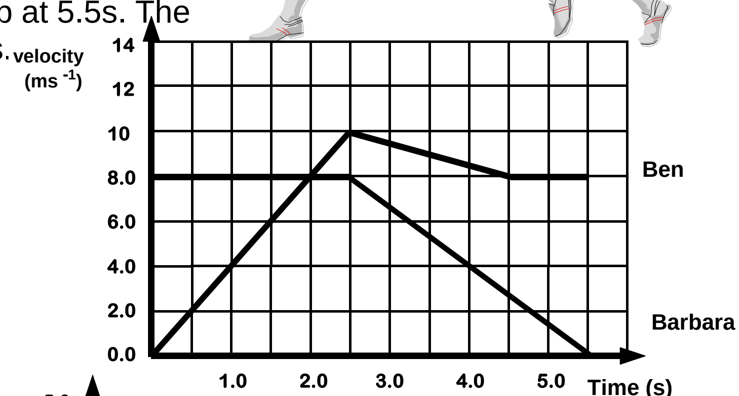
(c) Calculate this constant velocity.

Mary breaks the tape and then slows down from a velocity of 8.8ms^{-1} to a stop in 6.0s.

(d) How far did Mary run while she was slowing down?

QUESTION FOUR: MOTION GRAPHS.

Changing the relay baton: Barbara and Ben are members of the relay team. The velocity-time graph shown below shows the motion of both runners from the time when Ben starts to run and receives the baton from Barbara, until Barbara slows to a stop at 5.5s. The runners are at the same position on the track at 2.5s.



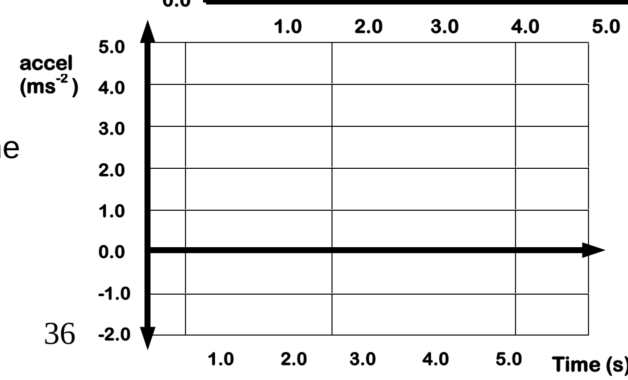
(a) Calculate Ben's acceleration in the first 2.5s.

(b) Show that the distance Ben moved in the first 2.5s was 12.5m.

(c) Determine how far Ben was in front of Barbara when she first started to move.

(d) Calculate Barbara's average velocity over the complete motion shown.

(e) Draw, on the graph, the acceleration - time graph of Ben's motion.



QUESTION FIVE: A 65.0 kg trampolinist bounces on a trampoline. On one bounce he leaves the trampoline at a speed v, and reaches a maximum height above the trampoline of 3.60 m.

(a) On the downward part of the bounce, when the trampolinist is in contact with the trampoline, work is done on the trampoline. State the type of energy stored in the trampoline at the bottom of the bounce.

(b) Calculate the gain in gravitational potential energy of the trampolinist when he is at maximum height above the trampoline.

(c) Calculate the velocity, v, the trampolinist left the trampoline with.

(d) State any assumptions you made to calculate the velocity in part c.

Circles AND Springs Revision Questions

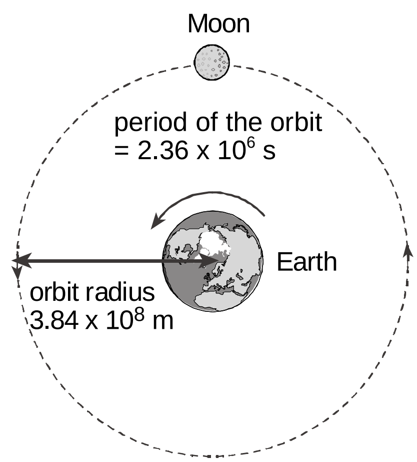
$v = \frac{\Delta d}{\Delta t}$ $\quad a = \frac{\Delta v}{\Delta t}$ $\quad v_f = v_i + at$ $\quad d = v_i t + \frac{1}{2}at^2$ $\quad d = \frac{v_i + v_f}{2}t$ $\quad v_f^2 = v_i^2 + 2ad$

$F = ma$ $\quad \tau = Fd$ $\quad F = -kx$ $\quad E_p = \frac{1}{2}kx^2$ $\quad F_c = \frac{mv^2}{r}$ $\quad a_c = \frac{v^2}{r}$

$p = mv$ $\quad \Delta p = F\Delta t$ $\quad E_k = \frac{1}{2}mv^2$ $\quad \Delta E_p = mg\Delta h$ $\quad W = Fd$ $\quad P = \frac{W}{t}$

Acceleration due to gravity = $10 ms^{-2}$

QUESTION ONE: Lunar Orbit



The diagram shows the Moon's circular orbit around the Earth. The radius of its orbit about the centre of the earth is 3.84×10^8 m. The period of the orbit is 2.36×10^6 s.

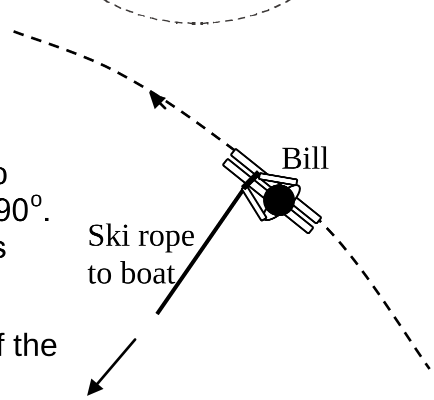
(a) The Moon travels in its orbit with a constant speed but it has an acceleration. Give a clear explanation of why this is.

(b) Show that the speed of the Moon in its orbit is 1.02×10^3 m s^{-1}.

(c) The mass of the moon is 7.30×10^{22} kg. Calculate the size of the centripetal force acting on the Moon in its orbit.

(d) State the direction of the centripetal force acting on the Moon in its orbit.

QUESTION TWO: water skiing

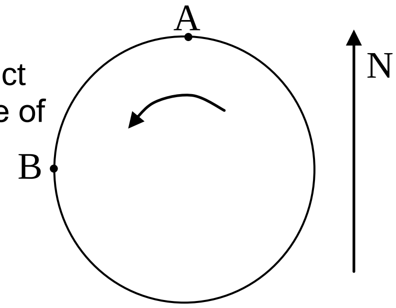


While Bill is water skiing, the boat goes round in a circular path and Bill is pulled around in an even wider circle at a constant speed as he holds onto the ski rope. The angle the ski rope makes with Bill's direction of travel is 90^o.

(a) On the diagram draw a labelled arrow showing the direction of Bill's centripetal acceleration.

(b) From the list given, circle the word that best describes the nature of the force on Bill that is the cause of his centripetal acceleration.

gravity friction tension centrifugal



(c) Bill is traveling at a constant speed of 14 ms^{-1}. He completes one perfect circle in 40 seconds. Bill's total mass is 58 kg. Calculate the magnitude of the centripetal force on him.

(d) Draw arrows at A and B to show Bill's velocity at these points in the circle which are 10 seconds apart. (T = 40s)

(e) Bill's speed was constant at 14 ms^{-1}. With the aid of a sketched vector diagram, calculate his change in velocity as he moves from point A to point B. (State the direction of this change in velocity vector as a bearing.)

QUESTION THREE: Springs

(a) In your own words describe what the spring constant tells you about a certain spring.

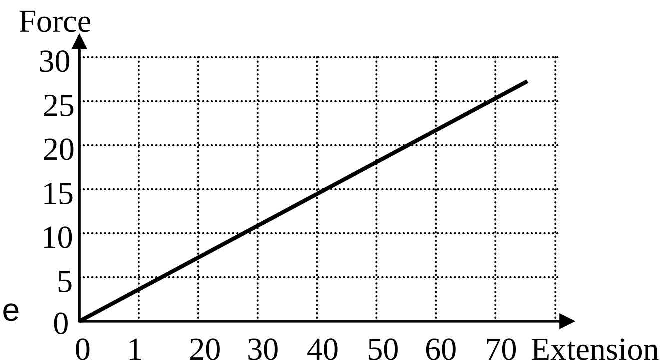
(b) Explain how you would do an experiment to determine the spring constant of a spring. Explain what measurements you would take and describe how you would analyse the data obtained.

(c) A steel cable is used to pull a boat out of the water and onto its trailer. If the force required to pull the boat up is 1200 N, calculate the amount that the cable stretches if the cable has a spring constant of 2.0 x 10^5 Nm^{-1}?

(d) The graph shows Hooke's law data for a particular spring. Calculate
(i) the spring constant.

(ii) the energy used to stretch the spring by 35 cm.

(iii) What characteristic of the graph represents the work done in stretching the spring?



(e) A 30 cm spring is hung from the ceiling and a mass of 1.2 kg is hung from it. The spring stretches to a new length of 38 cm.
(i) What is the magnitude of the extension force operating?

(ii) What is the spring constant of the spring?

(iii) How much elastic potential energy is stored in the spring?

QUESITON FOUR:
Helga has a habit of playing with springs. She's collected a few springs and decides to determine the "stretchiness" of her springs.

(a) What is the physics term for the "stretchiness" of a spring? Explain what it means if this "stretchiness" has a large or small value.

(b) One of her springs has an original length of 185cm. Helga attaches 790g and measures the length of the spring to be 245cm. By showing all the steps required: ***Show*** that the stiffness of this spring is 13. Give a unit for your answer of the spring's stretchiness.

(c) Calculate the energy stored in the spring with a new mass of 915g attached.

(d) Use a labelled graph of F vs x and calculations to ***SHOW*** that the work done to stretch the spring from 200cm to 240cm is ≈ 1.8J.

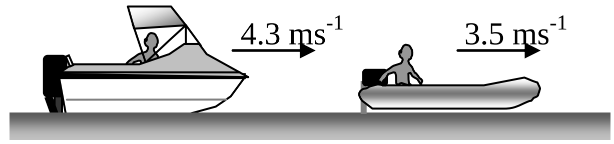
Momentum AND Projectiles Revision Questions

$v = \frac{\Delta d}{\Delta t}$ $a = \frac{\Delta v}{\Delta t}$ $v_f = v_i + at$ $d = v_i t + \frac{1}{2}at^2$ $d = \frac{v_i + v_f}{2}t$ $v_f^2 = v_i^2 + 2ad$

$F = ma$ $p = mv$ $\Delta p = F\Delta t$ $E_k = \frac{1}{2}mv^2$ $\Delta E_p = mg\Delta h$ $W = Fd$ $P = \frac{W}{t}$

Acceleration due to gravity = 10ms^{-2}

QUESTION ONE: Boating



Bill's uncle is in a rubber inflatable boat that has a total mass of 180 kg. Bill and his dad are following the inflatable in their fiberglass boat (total mass = 1080 kg) and accidentally bump into it from behind. At the instant of the collision Bill's boat is traveling at 4.3 ms^{-1} and his uncle is traveling at 3.5 ms^{-1}.

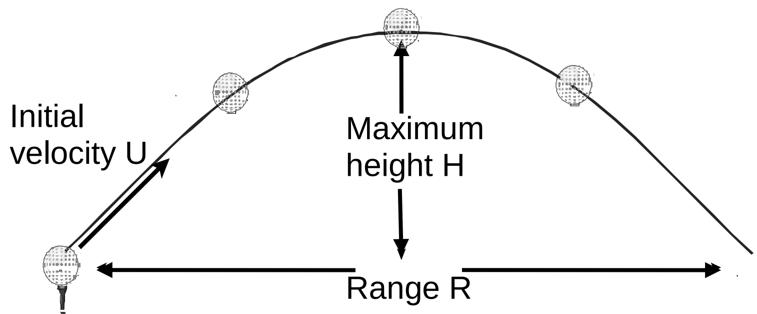
(a) Calculate the momentum of Bill's boat before the collision.

(b) Immediately after the collision, the rubber inflatable boat is traveling at 4.8 ms^{-1}. Show that its change in momentum is 230 $kgms^{-1}$. (2sf)

(c) Calculate the speed of Bill's fiberglass boat after the collision.

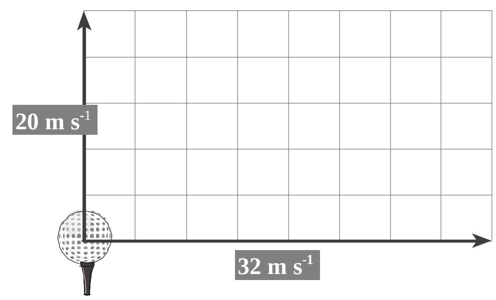
(d) Show by appropriate calculations whether the collision is elastic or inelastic.

QUESTION TWO: Golfing



The diagram shows the path of a golf ball from the time it leaves the golf club to when it hits the ground. The initial velocity of the golf ball is U ms^{-1}. It travels a horizontal distance (range) of R metres and a maximum height of H metres.
In this question ignore the air resistance acting on the golf ball.

(a) The path of the ball is a projectile. Explain what a projectile path means. The diagram on the right shows the horizontal and vertical components of the initial velocity (U) of the golf ball.



(b) Draw clearly on the diagram a velocity vector to represent the size and direction of the initial velocity (U) of the golf ball.

(c) Calculate the size and direction of the initial velocity U of the golf ball.

(d) Explain the motion of the golf ball in the vertical direction. Give a reason for your explanation.

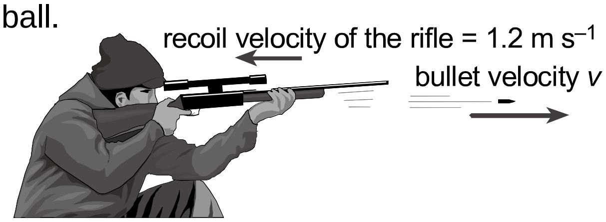
(e) Show that the time taken for the golf ball to reach the top of its flight is 2.0 seconds.

(f) Calculate the maximum vertical height reached by the golf ball at the top of its flight.

(g) Explain the motion of the golf ball in the horizontal direction, Give a reason for your explanation.

(h) Calculate the horizontal distance travelled by the golf ball.

QUESTION THREE: target shooting



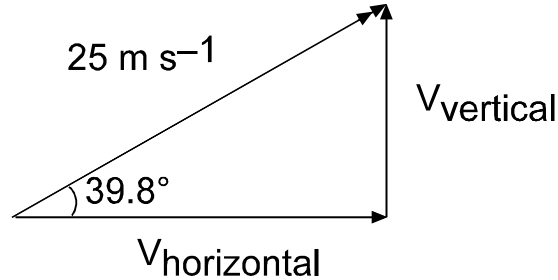
A hunter practises shooting by firing at a target. The mass of the rifle without the bullet is 9.2 kg. The mass of the bullet is 0.086 kg.
The diagram shows the recoil of a rifle as a hunter fires it. The recoil velocity of the rifle is 1.2 ms^{-1}.

(a) Write down the value of the total momentum of the rifle and bullet just before firing.

(b) Write down the value of the total momentum of the rifle and bullet just after firing. Explain clearly the principle you used to find this value.

(c) Show that the velocity of the bullet as it leaves the rifle is 128.4 ms^{-1}.

(d) If the firing of the bullet took 0.037 s, calculate the value of the average force acting on the bullet during this time.



QUESTION FOUR: hammer throw

Bubby throws a hammer of 7.26kg at an angle. As the hammer is released, the ball is moving 25 ms^{-1} at an angle of 39.8° to the horizontal.

(a) Show that the horizontal component of the velocity of the ball as it is released is 19ms^{-1}

(b) Show that the vertical component of the velocity of the ball as it is released is 16ms^{-1}

After release, the hammer is in the air for 3.2 s before landing.

(c) Calculate the distance of the throw.

(d) Calculate the maximum height reached by the hammer during its flight.

(e) State the forces acting on the hammer during its flight.

(f) Describe the motion of the hammer during its flight.

(g) The kinetic energy of the hammer at the instant it is released is 2270 J. The athlete takes 2.4 s to get it up to maximum speed. What is the power supplied by the athlete to give the hammer this amount of kinetic energy?

Torque AND Vectors Revision Questions

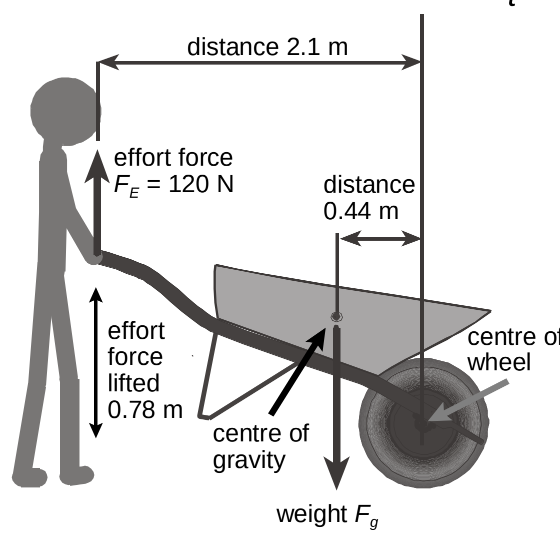
$v = \frac{\Delta d}{\Delta t}$ $a = \frac{\Delta v}{\Delta t}$ $v_f = v_i + at$ $d = v_i t + \frac{1}{2}at^2$ $d = \frac{v_i + v_f}{2}t$ $v_f^2 = v_i^2 + 2ad$

$F = ma$ $\tau = Fd$ $p = mv$ $\Delta p = F\Delta t$ $E_k = \frac{1}{2}mv^2$ $\Delta E_p = mg\Delta h$ $W = Fd$ $P = \frac{W}{t}$

Acceleration due to gravity = 10ms^{-2}

QUESTION ONE: forces on a wheelbarrow

The diagram shows a person lifting the handles of a wheelbarrow by exerting an effort force (F_E) of 120 N through a vertical height of 0.78 m. The weight of the load (including the wheel barrow) is F_G.



(a) Show that the work done by the person in lifting the wheelbarrow is 93.6 J.

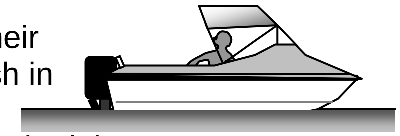
(b) The person takes 0.95 s to lift the wheelbarrow through a height of 0.78m. Calculate the power required to lift the wheelbarrow. Give your answer to the correct number of significant figures.

(c) Calculate the size of the torque exerted by the effort force FE about the centre of the wheelbarrow's wheel. Give a unit with your answer.

(d) When the person has lifted the wheelbarrow, the person and the loaded wheelbarrow are in equilibrium. Calculate the combined mass of the load and wheelbarrow.

(e) Give a clear explanation of the physical principle used to solve the problem in (d).

QUESTION TWO: Boating



Bill and his dad are keen on boating and they often go out together in their small fiberglass boat. They live in the Waikato region and sometimes fish in the Waikato River or in Lake Taupo. In summer the family enjoy water sports such as water skiing and wake-boarding in the lake.

(a) Bill and his dad are traveling up a stretch of the Waikato River in their boat. The river current is 0.80 ms^{-1} and they are traveling upstream against the current at 2.3 ms^{-1}.
What is the velocity of the boat relative to the river bank?

They anchor the boat in the middle of the river, 25 m from the bank. Bill's mum arrives on the river bank with a picnic lunch and Bill decides to swim to her. He gets into the water and swims away from the boat at right angles to the current and the bank at a speed of 1.1 ms^{-1}.
The river current is still 0.80 ms^{-1} East.

(b) Show that it will take Bill 23 seconds to reach the bank.

(c) Calculate how far downstream Bill travels while he is swimming to the bank.

(d) Sketch a vector diagram showing the three velocity vectors: Vector 1: Bill's velocity relative to the water, Vector 2: The water's velocity relative to the bank, and Vector 3: Bill's velocity relative to the bank. Correctly label the vectors 1, 2 and 3. On your diagram mark in the angle θ that vector 3 makes with vector 2.

(e) (i) Calculate the magnitude of Vector 3 (Velocity of Bill relative to the bank).
(ii) Calculate the value of angle θ.

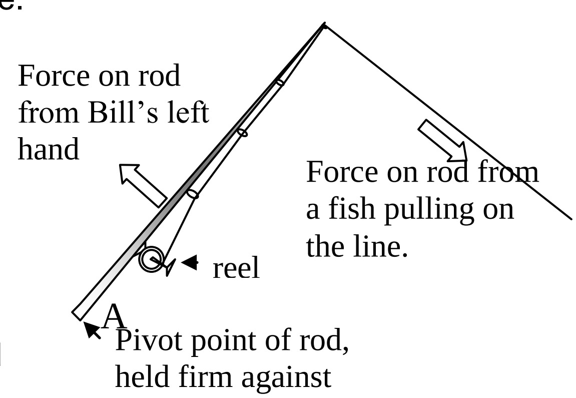
QUESTION THREE: fishing

While fishing for trout in the lake, Bill uses a fishing line that the packaging says will not break until the "weight force" on it is 4.0 kg. (for this question use g = 9.8 Nkg^{-1})

(a) Calculate the actual force in Newtons that would break Bill's line.

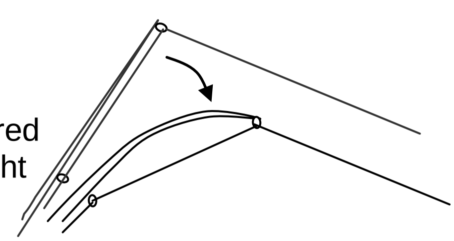
(b) The line has other specifications. One of these is that it will be stretched by one meter for every hundred meters of line when the breaking force you calculated in (a) is applied to it. Calculate the value of the line's spring constant "k" for a 100 m length of line.

Bill thinks that the best way to hold his rod when he is pulling in a fish is to anchor the end of the rod handle against his belt as a pivot (point A on the diagram), and use his left hand to hold the rod as far up the handle as he can. He thinks that this gives him the most "leverage" on the fish as he winds it in with his right hand on the reel.



(c) The rod is 2.1 m long and Bill's left hand is 50 cm from the bottom of the rod. Calculate the force on the rod from Bill's hand if the fish is exerting a force of 30 N. (Assume the rod does not bend.)

(d) In practice the end of the rod bends as shown in the diagram. Explain, in terms of the forces operating, how this bending of the rod near its tip makes it "easier" to pull in the fish.



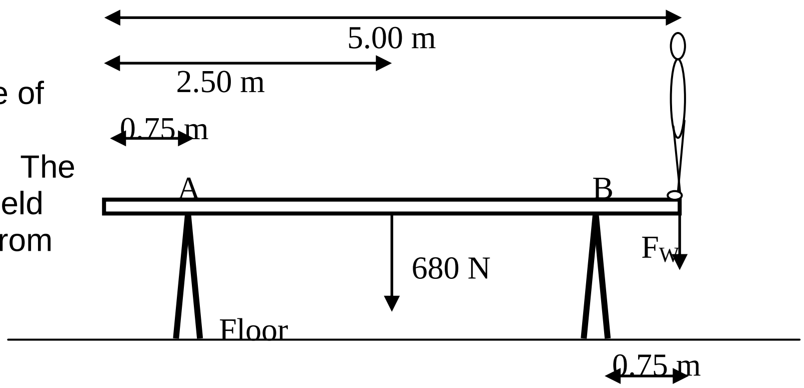
(e) When Bill casts his line out, the lure on the end of it follows a parabolic path. (A lure is a piece of metal that is shaped and coloured to resemble a small fish and it is fitted with a hook) The time of flight of the lure through the air is 3.4 seconds. Calculate the maximum height of the lure in its projectile motion.

(f) In practice, the path of the lure would not be a symmetrical parabola. Comment on why this would be so.

(g) Explain why Bill is able to cast the same lure a greater distance when he uses a longer rod.

QUESTION FOUR:

A popular Olympic event is gymnastics. Female gymnasts compete on four types of apparatus, one of which is the 5.00m long balance beam. A 40.0kg gymnast stands at one end of the beam as shown. The beam is uniform and weighs 680N. The beam is held off the ground by two supports, which are 0.75 m from each end of the beam.



(a) Calculate the weight force of the gymnast, labeled F_W in the above diagram.

(b) Show that the sum of the clockwise torques about point A is 2890 Nm.

(c) State the two conditions for equilibrium to occur.

(d) Assuming the beam is in equilibrium, determine the anticlockwise torque about point A.

(e) Calculate the support force at A.

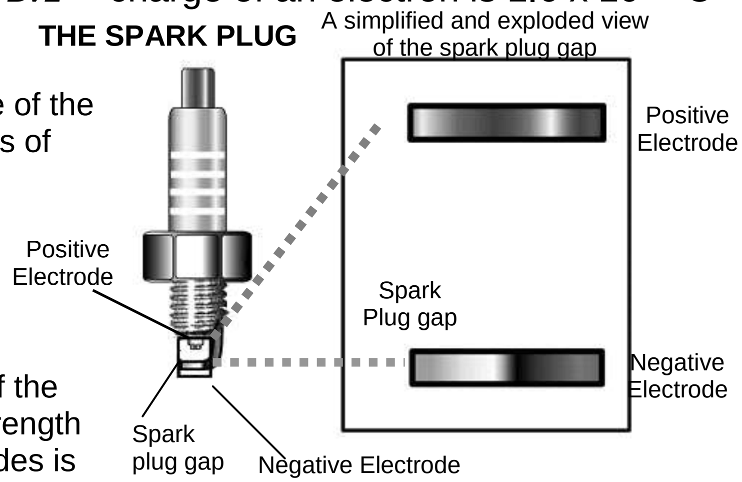
Electric Fields Revision Questions

$I = \frac{q}{t}$ $V = \frac{\Delta E}{q}$ $V = IR$ $P = IV$ $P = \frac{\Delta E}{t}$ $E = \frac{F}{q}$ $E = \frac{V}{d}$ $\Delta E = Eqd$

$F = BIL(\sin\theta)$ $F = Bqv$ $V = BvL$ charge of an electron is 1.6×10^{-19} C

QUESTION ONE: spark plugs

The diagram shows a spark plug in the engine of the camper van. The voltage across the electrodes of the spark plug is 40,000 V.



(a) On the simplified diagram above, draw lines to show the correct shape and direction of the electric field formed between the plates.

(b) The distance between the electrodes of the spark plugs 0.80 mm. Show that the strength of the electric field between the electrodes is 5.0×10^7 Vm^{-1}.

(c) Electric field strength is measured in Vm^{-1}. Give another SI unit for electric field strength.

(d) Calculate the force experienced by an electron in the electric field given in (b).

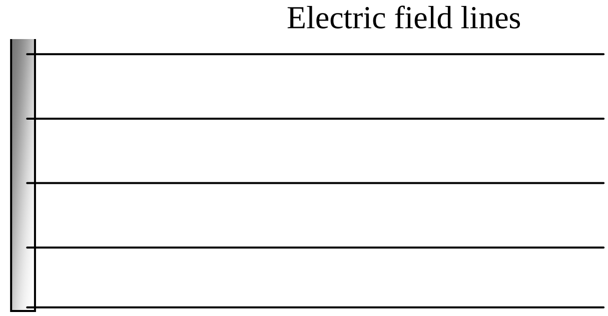
(e) Calculate the gain in kinetic energy of each electron as it moves across the spark plug gap.

QUESTION TWO: industrial process

In large industries, furnace chimneys use electrostatic precipitators to remove 99% of the dust and ash from the smoke before it is released into the atmosphere. This reduces pollution enormously.

A typical electrostatic precipitator has discharge electrodes in the path of the smoke. These are wires that release electrons onto the particles in the smoke to make them have a negative charge. As the negatively charged particles travel further up the chimney they pass over metal collector plates which are commonly maintained at +60,000V. The negatively charged particles are attracted to the plates and stick to them. From time to time the plates are disconnected from the power supply and vibrated to allow the dust to fall off and be collected.

The field near a metal collector plate is uniform and a small cross-section of it is represented on the diagram. The strength of the field shown is $120{,}000 \text{Vm}^{-1}$.



(a) Electric field strength can be expressed using another unit as well as Vm^{-1}. Write the symbols for this other unit.

(b) The collector plate carries positive 60,000 Volts. Draw arrow heads on the field lines to show the electric field direction.

(c) A piece of dust is carrying an electric charge of $3\text{x}10^{-10}$ C as it passes through this field. Calculate the size of the force on the particle.

(d) The piece of dust in (b) is 28 cm from the plate. Calculate the electric potential (voltage) at this point in the electric field.

(e) Calculate the work done on the smoke particle by the electric field as it is carried from the position mentioned in (c), a distance of 28 cm, to the surface of the plate.

(f) In a particular chimney with an operating voltage of 60,000V this electrostatic dust removal process consumes 20,000W. Estimate the amount of charge that is carried by dust from the discharge electrodes onto the collector plates every second.

DC Circuit Revision Questions

$$I=\frac{q}{t} \qquad V=\frac{\Delta E}{q} \qquad V=IR \qquad P=IV \qquad P=\frac{\Delta E}{t} \qquad R_T=R_1+R_2+\ldots \qquad \frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}+\ldots$$

QUESTION ONE: Bus Lighting

Reo wires a camper van with ten identical light bulbs. Each bulb is marked as "24 V, 10 W". The voltage of the battery that powers the lights is 24 V.

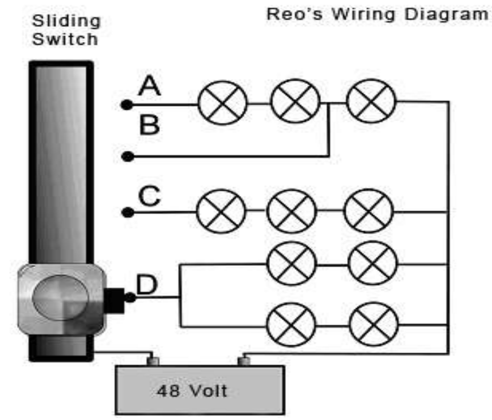
(a) Describe what is meant by the term voltage.

Initially, Reo connects all ten bulbs in series with a 24 V battery and turns on the switch. The total power drawn from the battery is 1.0 W.

(b) Show that the total working resistance of all ten bulbs wired in series is 576 Ω.

(c) Calculate the amount of charge that flows through the bulbs during 45 minutes.

Reo notices that the bulbs are dimly lit. He decides to redo the wiring using a sliding switch. He uses a 48 V battery and ten new identical bulbs, each bulb marked as “48 V, 40 W”. The sliding switch allows only one set of lights to be connected at one time. The circuit diagram of his completed wiring is shown.



Each bulb has a working resistance of 15 Ω. The sliding switch is set to position D as shown in the diagram.

(d) Show that the total resistance of the circuit is 15 Ω.

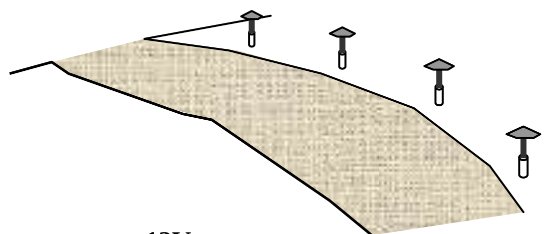
(e) Calculate the current drawn from the battery by the four bulbs when the switch is set to position D.

(f) Show that the power output from each bulb is 38.4 W when the switch is left in position D.

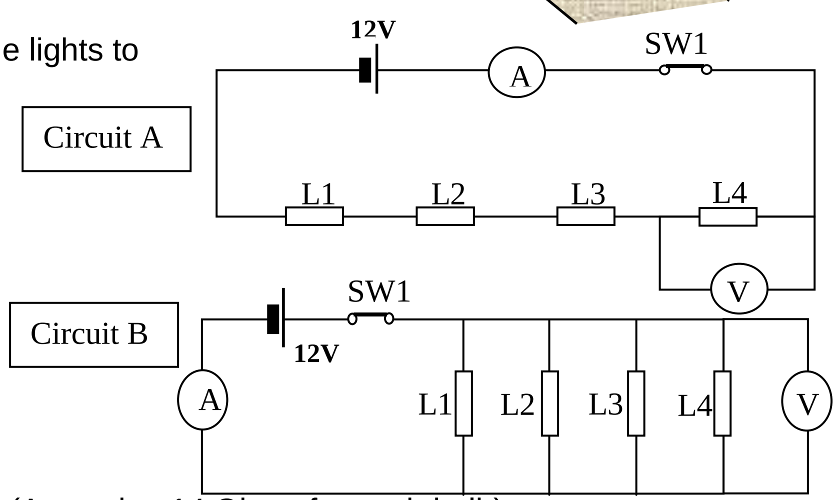
(g) The switch is kept in position D for 45 minutes. Calculate the total electrical energy drawn from the battery. Write your answer to the correct number of significant figures.

QUESTION TWO: Power Supply

John has a power supply which runs off the mains and can deliver 12V at a maximum current of 5 Amps. He makes four garden light fittings which each contain a single 10 Watt bulb. John wants to connect them into a circuit and run them off his power supply to illuminate one side of the drive at his house.



John tries out two wiring circuits (A and B) on the lights to see which one is best. (L = light, SW = switch)



(a) Name the arrangement of the lights in the two circuits.

(b) In each circuit John briefly attached a voltmeter to L4 as shown. What will be the two readings on the voltmeter?

(c) If each light bulb is rated at 10W when connected on its own to 12V, show that the resistance of each single bulb is 14Ohms.

(d) Calculate the total resistance of circuit A. (Assuming 14 Ohms for each bulb)

(e) Calculate the current reading on the ammeter in circuit B

(f) Calculate how much energy will be used by L4 in circuit B over a one hour period.

John decides that he wants the light nearest to the house to be maximum brightness and the other three dimmer.

(g) Draw a suitable circuit for this set-up. Please label the lamp nearest the house as L4.

(h) Comment on the advantages and disadvantages of circuit A compared to circuit B.

(i) John noticed that his power supply had a light emitting diode (LED) on its front panel that glowed whenever the power supply was switched on.
   - (i) Describe one other use of diodes.
   - (ii) Draw a simple circuit containing a battery, a light bulb and a diode. Connect the three components so that electric current passes through the diode and makes the light bulb glow.

QUESTION THREE: KAHURANGI POWER COMPANY

The Kahurangi Power Company charges its customers 18 cents per kWh. This means that it costs 18 cents to use a 1kW device for one hour.

(a) Calculate how much it would cost to run a 2400W heater for one hour.

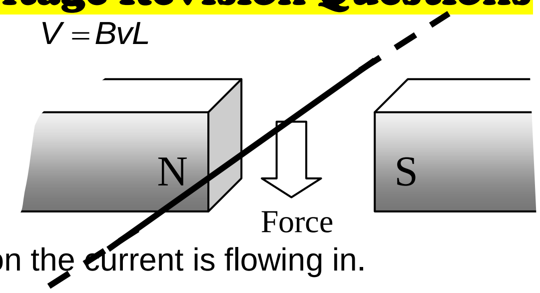
(b) Calculate the cost to run a TV, of resistance 60Ω, for 1.0 hour from a 220V source.

Forces with Magnets AND Induced Voltage Revision Questions

$F = BIL(\sin\theta)$ $F = Bqv$ $V = BvL$

Question ONE:

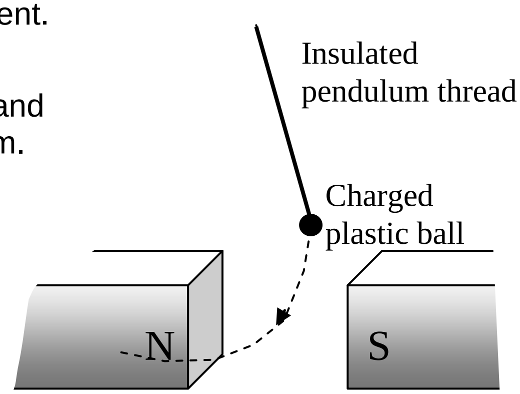
A wire is placed in between two magnetic poles as shown in the diagram below. The wire is part of an electric circuit. When the current is switched on the wire experiences a downwards force.



(a) (i) Draw an arrow on the wire to show which direction the current is flowing in.

(ii) The strength of the magnetic field through the wire is 0.13 T. The wire is at right angles to the field and the length of wire in the field is 3 cm. If the downwards force experienced by the wire is 0.02 N, calculate the magnitude of the current.

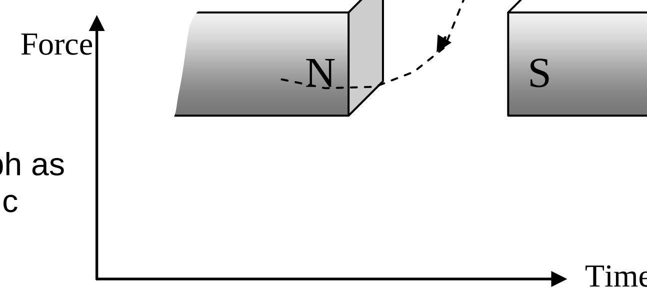
The wire and circuit used in (a) is removed and a small plastic ball hanging on a pendulum is given a negative charge of 3.9×10^{-5} C and allowed to swing through the magnetic field as shown in the diagram. The maximum speed of the ball as it passes through the magnetic field is $2 ms^{-1}$. The magnetic field strength is 0.13 T



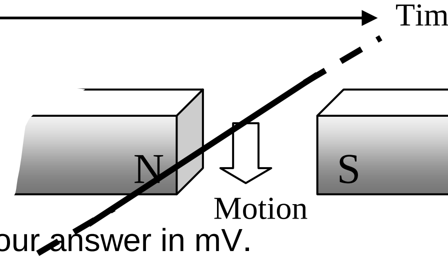
(b) Calculate the magnitude of the magnetic force on the ball at its maximum velocity.

(c) Describe the direction of the magnetic force you calculated in (b)

(d) Sketch the expected shape of the force-time graph as the ball swings across once between the magnetic poles. Explain your shape giving clear reasons.



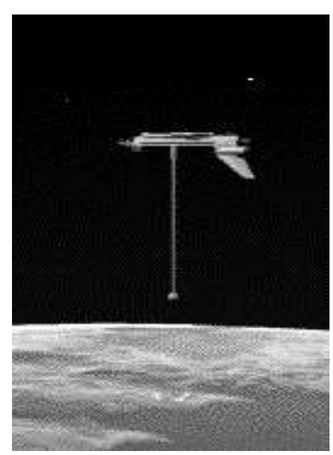
In a third experiment, the wire circuit and magnets are used again only this time the battery is replaced by a sensitive Voltmeter. The wire is pushed down through the magnetic field at a speed of $3 ms^{-1}$ The length of wire passing through the magnetic foiled is still 3 cm and the magnetic field strength remains 0.13 T.



(e) Calculate what the reading will be on the Voltmeter. Express your answer in mV.

Question TWO:

In 1996, electricity was produced in space when the Columbia Space Shuttle moved a 19.7km conductor through the Earth's magnetic field. This device generated 3,500 V and 0.50 A of current.



(a) The average magnetic force experienced by the conductor is 0.23 N. Show that the average magnetic field strength of the earth is 2.3×10^{-5} T.

(b) Explain three assumptions you have made in calculating the earth's magnetic field strength in (a).

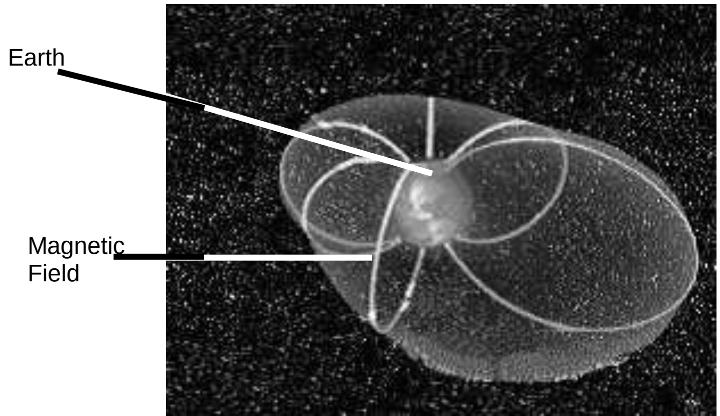
(c) Explain why the system could not be used for electricity generation.

(d) Calculate the speed of the conductor across the earth's magnetic field.

(e) State two ways in which greater voltage can be produced using this method.

Question THREE:

Clouds of ionized gases containing protons or electrons from the solar wind become trapped in the earth's magnetic field to form the aurorae (or northern lights and southern lights). The solar wind, travelling at 630 km s^{-1}, hits the earth's magnetic field and is directed toward the magnetic poles, where these particles release their energy in the form of light.



Assume that the charged particles are moving at 90º to the magnetic field.

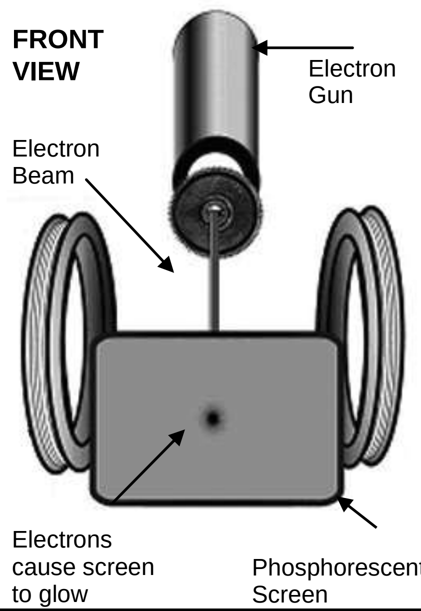
(a) Each particle has a charge of 1.6×10^{-19} C and its experiences a force of 2.5×10^{-15} N. Calculate the size of the earth's magnetic field.

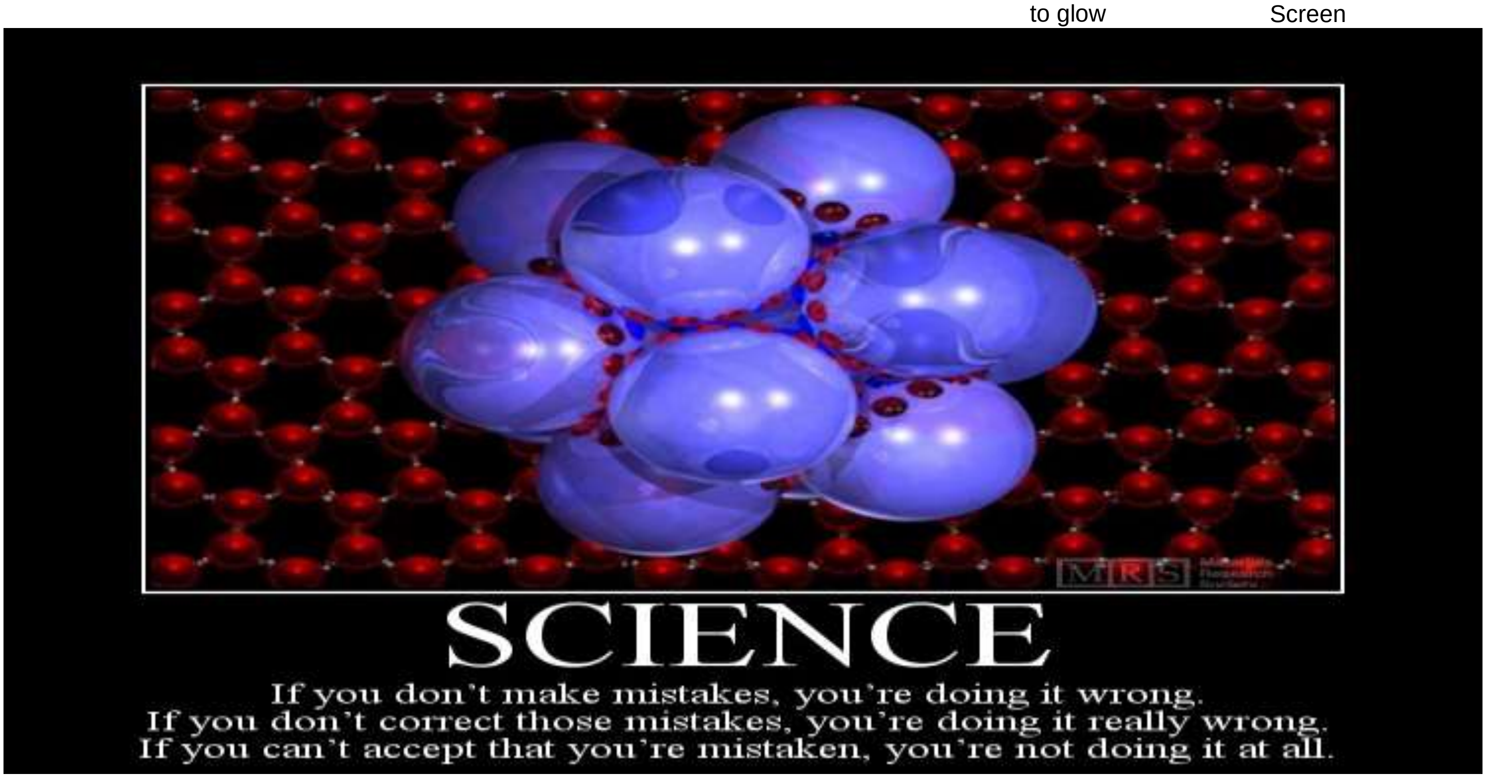
The deflection of charged particles by a magnetic field can be studied by using the following set up. An electron gun fires a beam of electrons onto the screen. When a current passes through the coils it produces a magnetic field across the path of the electron beam.

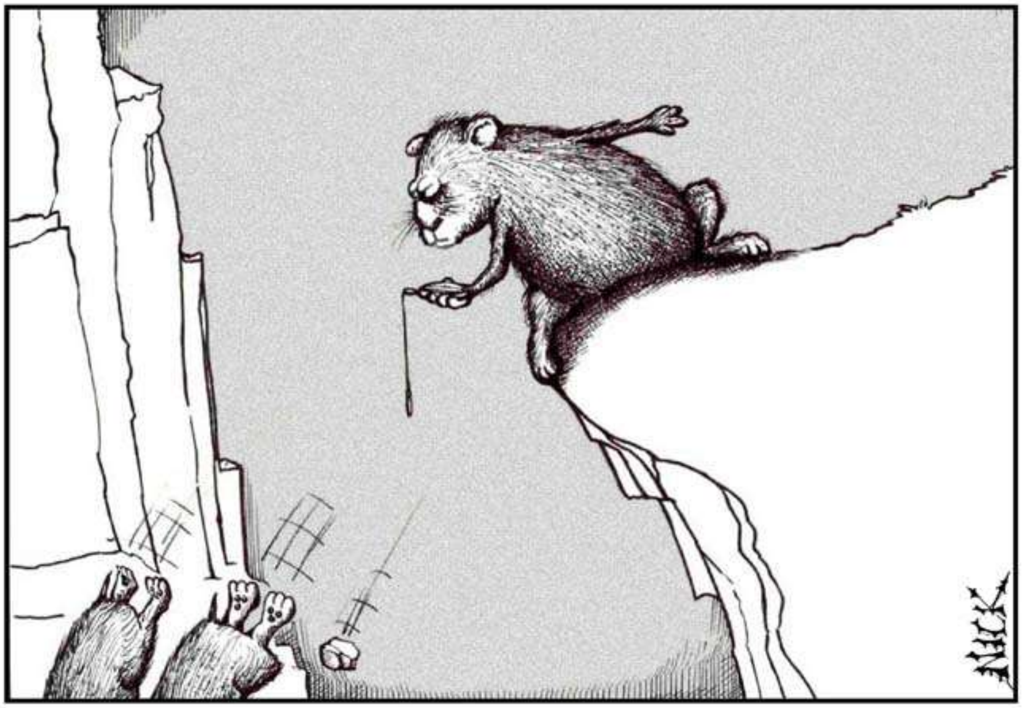
When the coils are magnetised the beam deflects upwards.

(b) Draw the shape and direction of the magnetic field produced by the coils.

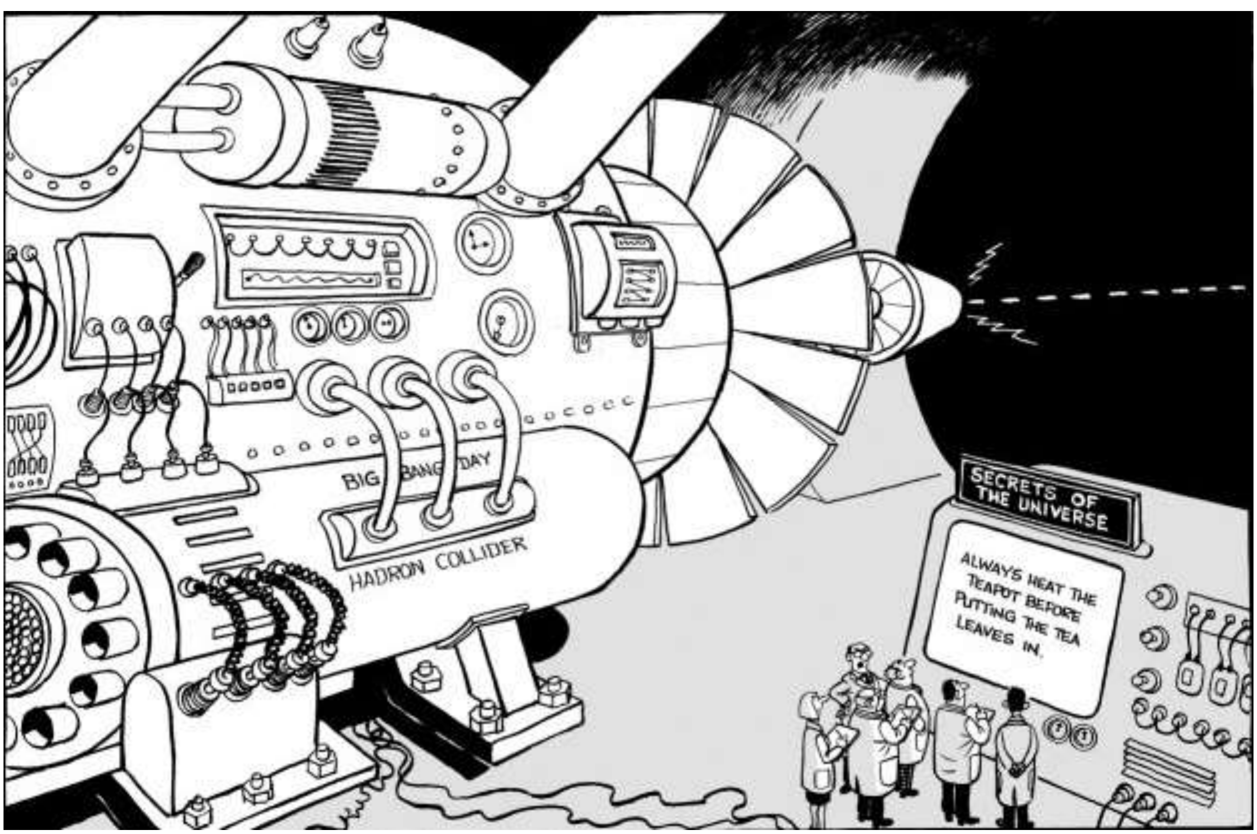
(c) Explain how you obtained the direction of the magnetic field.







Fluffy, the "Galileo of the Lemmings," with his stopwatch.



2013 TGS L2 Physics External Standards Material (from NZQA NCEA standards as of Feb 2012)

P2.3 waves (91170) 4 credits

Light:

- reflection in curved mirrors,
- refraction through lenses,
- refraction,
- total internal reflection & critical angle at a plane boundary.

Waves:

- reflection and refraction at a plane boundary including phase and wave parameter changes if applicable
- superposition of pulses
- diffraction through a slit
- 2-point source interference (qualitative).

Relationships: $\frac{1}{f}=\frac{1}{d_o}+\frac{1}{d_i}$ or $s_i s_o = f^2$; $m=\frac{d_i}{d_o}=\frac{h_i}{h_o}$ or $m=\frac{f}{s_o}=\frac{s_i}{f}$;

$n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\frac{n_1}{n_2}=\frac{v_2}{v_1}=\frac{\lambda_2}{\lambda_1}$ $v=f\lambda$ $f=\frac{1}{T}$ $v=\frac{d}{t}$

P2.4 mechanics (91171) 6 credits

***Motion*:**

- constant acceleration in a straight line
- free fall under gravity
- projectile motion
- circular motion (constant speed with one force only providing centripetal force).

***Force*:**

- force components
- vector addition of forces
- unbalanced force and acceleration
- equilibrium (balanced forces and torques)
- centripetal force
- force and extension of a spring.

***Momentum and Energy*:**

- momentum
- change in momentum in one dimension and impulse
- impulse and force
- conservation of momentum in one dimension
- work
- power and conservation of energy
- elastic potential energy.

Relationships: $v=\frac{\Delta d}{\Delta t}$ $a=\frac{\Delta v}{\Delta t}$ $v_f = v_i + at$ $d = v_i t + \frac{1}{2}at^2$ $d=\frac{v_i+v_f}{2}t$

$v_f^2 = v_i^2 + 2ad$ $a_c = \frac{v^2}{r}$ $F=ma$ $\tau = Fd$ $F=-kx$ $F_c = \frac{mv^2}{r}$

$p=mv$ $\Delta p = F\Delta t$ $E_p = \frac{1}{2}kx^2$ $E_k = \frac{1}{2}mv^2$ $\Delta E_p = mg\Delta h$ $W=Fd$ $P=\frac{W}{t}$

P2.6 electricity and electromagnetism (91173) 6 credits

***Static Electricity*:**

- uniform electric field
- electric field strength
- force on a charge in an electric field
- electric potential energy
- work done on a charge moving in an electric field.

***Electromagnetism*:**

- force on a current carrying conductor in a magnetic field
- force on charged particles moving in a magnetic field
- induced voltage generated across a straight conductor moving in a uniform magnetic field.

***DC Electricity*:**

- parallel circuits with resistive component(s) in series with the source
- circuit diagrams
- voltage
- current
- resistance
- energy
- power.

Relationships: $E=\frac{V}{d}$ $F=Eq$ $\Delta E_p = Eqd$ $E_k = \frac{1}{2}mv^2$ $F=BIL$ $F=Bqv$ $V=BvL$

$I=\frac{q}{t}$ $V=\frac{\Delta E}{q}$ $V=IR$ $P=IV$ $P=\frac{\Delta E}{t}$ $R_T = R_1 + R_2 + \ldots$ $\frac{1}{R_T}=\frac{1}{R_1}+\frac{1}{R_2}+\ldots$