CRANBROOK SCHOOL
YEAR 11 – FINAL EXAM - 2000
PHYSICS

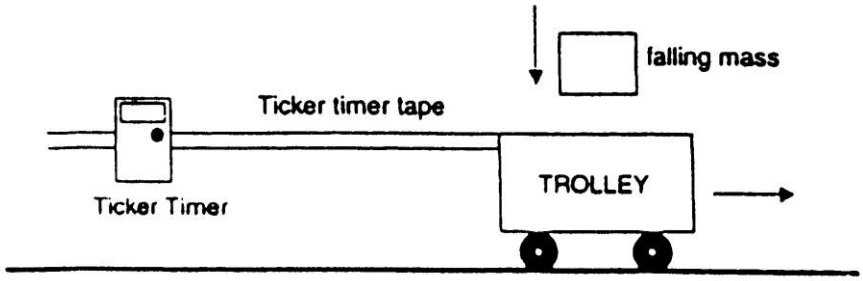
1. To test the effects of sound waves, three students devise an experiment involving one of them striking a disused section of railway track with a hammer. The other two students are positioned 1.0 km away with one of them positioning his ear on the track and the other listening through the air. Assume that the speed of sound in the steel track is 5000 m/s and in the air is 340 m/s. Which student will hear the sound first and by how much?

(A) The student listening through the air by 2.7 seconds.
(B) The student listening through the air by 2.7×10^{-3} seconds.
(C) The student listening on the track by 2.7 seconds.
(D) The student listening on the track by 2.7×10^{-3} seconds.

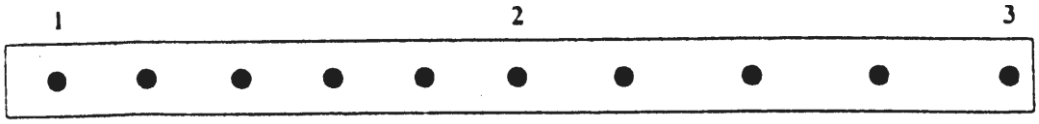
2. A Subaru travelling at 20 m/s east overtakes a slow moving Hyundai travelling at 15 m/s in the same direction. What is the speed of the Hyundai relative to the Subaru?

(A) 5 m/s east.
(B) 5 m/s west.
(C) 35 m/s east
(D) 35 m/s west.

3. A student obtains a piece of ticker tape for an experiment which involved vertically dropping a mass onto a moving trolley.

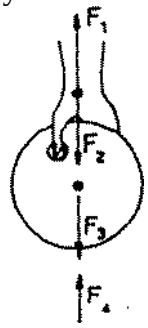


Because he has not been too careful he does not know which end of the tape is the start and which end is the finish.
Examine the tape below and then select the correct statement.



(A) Point 1 is the start of the tape, point 3 is the end, point 2 is where the mass was dropped.
(B) Point 3 is the start of the tape, point 1 is the end, point 2 is where the mass was dropped.
(C) Point 2 is where the mass was dropped, but the start of the tape cannot be determined.
(D) There is insufficient information on the tape to determine anything. The student will have to redo the experiment.

4. A bowler lifts a ball vertically out of a rack causing it to accelerate upwards.



F_1 is the force of hand on ball F_2 is the force of ball on hand F_3 is the force of earth on ball F_4 is the force of ball on earth.
Vectors are not shown to scale.
A correct statement for ft magnitudes of the forces is :

(A) $F_1 = F_2 = F_3 = F_4$
(B) $F_1 > F_2$, $F_3 = F_4$
(C) $F_1 > F_3$
(D) $F_2 < F_1$

5. Sound is not an electromagnetic wave because sound :

(A) can be reflected.
(B) can be absorbed.
(C) requires a medium for propagation.
(D) travels at different speeds in different substances.

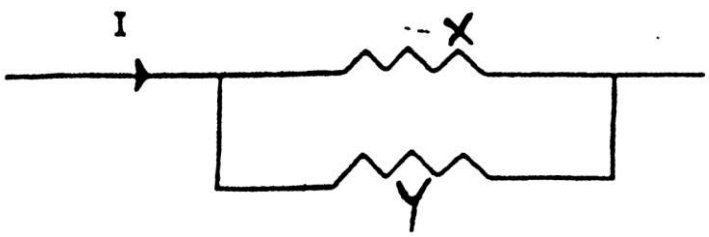
6. Which of the following would have the least resistance to the passage of an electric current?

(A) A long, thin piece of copper wire,
(B) A short, thick piece of copper wire.
(C) A long, thick piece of copper wire.
(D) A long, thick piece of perspex.

7. The gradient of a graph of current versus potential difference for an ohmic conductor

(A) is constant and represents its resistance.
(B) is constant and represents the inverse of resistance.
(C) will double if the potential difference doubles.
(D) is inversely proportional to the current.

8. Two resistors X and Y are connected as shown below.

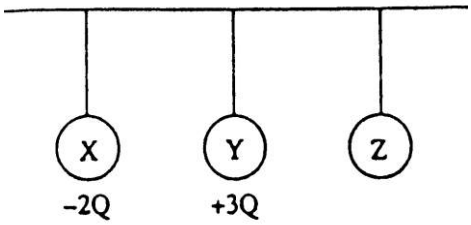


The resistance of X is twice that of Y.

Which of the following pairs of ratios are correct for the two resistors?

	Current in Y / Current in Y	Potential difference across X / Potential difference across Y
(A)	0.5	1
(B)	1	2
(C)	2	1
(D)	2	2

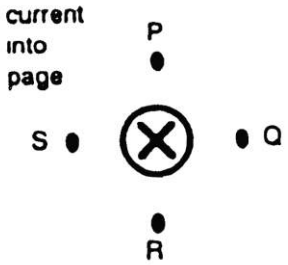
9. Three identical hollow metal spheres (X, Y, and Z) are suspended vertically by insulating threads.



Sphere X carries a charge of -2Q, sphere Y a charge of +3Q, and sphere z is neutral. Sphere Y is touched to sphere X and separated. Sphere Y is now touched to sphere Z and separated. What is the final charge on sphere Y?

(A) zero (B) +1.0 Q (C) -0.5 Q (D) +0.25 Q

10. The following diagram shows a conductor carrying an electric current into the plane of the page.



The direction of the magnetic field at points P, Q, R, and S are respectively

(A) → ↓ ← ↑

(B) ← ↑ → ↓

(C) → ↑ ↓ ←

(D) ↑ → ↓ ←

11. Which statement below is CORRECT?

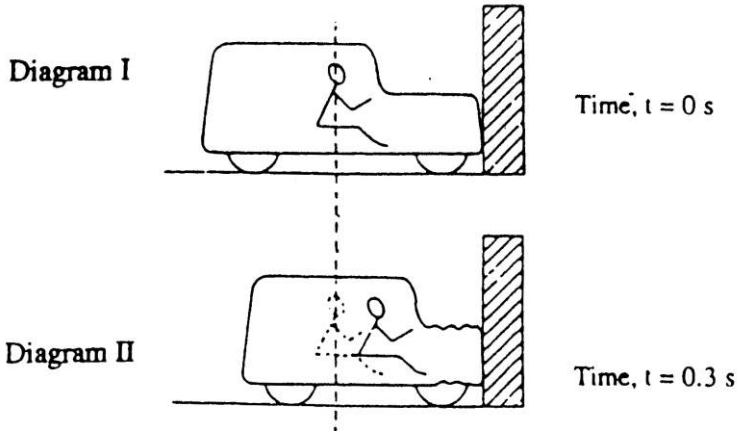
(A) An electric current in a straight wire produces a magnetic field in the opposite direction to the electron flow in the wire.
(B) An electric generator converts electrical energy into mechanical energy.
(C) Electric motors convert electrical energy into mechanical energy.

(D) Oersted's experiment showed that magnetic fields produce electric currents.

12. A jet plane of mass 200 000 kg has a speed of 80 m/s when its wheels contact the ground. It travels in a straight line and comes to rest at a uniform rate 3.2 km down the runway.

(a) Find the average speed of the plane along the runway. [1]
(b) Find the time taken to come to rest along the runway. [1]
(c) Calculate the average acceleration along the runway. [1]

13. During safety testing of seat belts, cars containing human-like dummies are crashed into barriers to measure the forces involved in the collision.

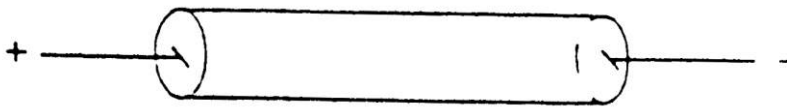


(a) Is the collision between the car and the wall elastic or inelasdc? Explain. [1]
(b) If the mass of the dummy is 80 kg and the initial velocity of the car was 22 m/s, calculate the change in momentum of the dummy as it comes to rest. [1]
(c) If the collision takes place in 0.3 seconds, calculate the net force exerted by the seat belt on the dummy. [1]
(d) Identify TWO other safety devices in modem cars and in terms of the relevant physics explain how they enhance the safety of the occupants in the event of a crash. [4]

14. The lead-acid accumulator battery of a car has two terminals labelled positive and negative. Between these terminals a potential difference of 12 V is maintained while the battery is delivering a current.

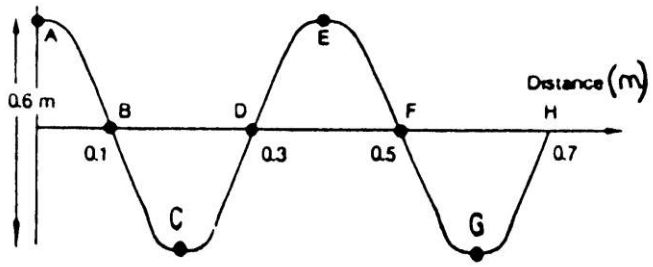
(a) Which terminal has the higher electric potential? Briefly explain. [1]
(b) When charging this battery 1.44×10^5 C of charge is moved. What work has to be done by the charger to fully recharge a completely discharged battery? {1]
(c) If the battery takes 30 minutes to be fully charged, what current flows between the terminals during this process? [1]

15. Between the electrodes of a neon street sign there exists a uniform electric field of magnitude 5.0×10^4 N/C. An ion of mass 3.3×10^{-26} kg inside this field carries a charge of $+1.6 \times 10^{-19}$C.



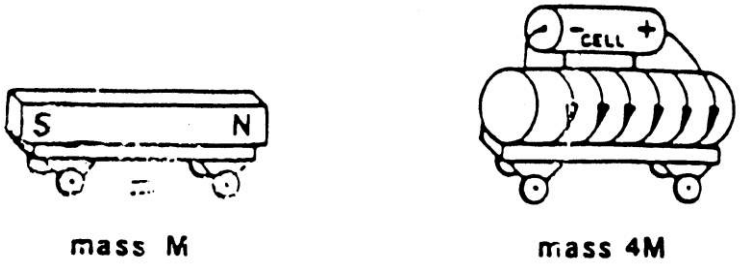
(a) On the diagram in the Answer Book, show the electric field lines inside the tube. [1]
(b)Find the magnitude of the acceleration this ion would experience inside the tube. [2]

16. The diagram below represents a photo of a wave in a string whose frequency is 4 Hz.



(a) Find the amplitude of the wave. [0.5]
(b) Find the wavelength of the wave. [0.5]
(c) Calculate the speed of the wave. [1]

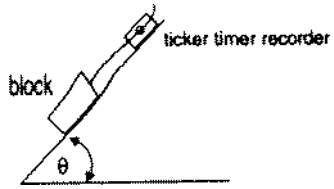
17. This question refers to the following diagram.



A permanent magnet and a solenoid and battery system are placed on separate, uncoupled trolleys on a smooth railway track and are free to move. The mass of the trolley plus the magnet is M kilograms and that of the trolley plus the solenoid and battery system is 4M kilograms.

(a) In what direction does each trolley move? Explain in terms of the physical principles involved why the motion takes place. [2]
(b) What is the ratio of the acceleration of the magnet trolley to the acceleration of the solenoid and battery trolley. [1]

18. In an experiment to determine the acceleration due to gravity, g, a block pulling a ticker tape through a recorder is allowed to accelerate down a smooth inclined plane. Any friction between the ticker timer and the ticker tape will be ignored.



The plane is inclined at 0 degrees to the horizontal. The value of the acceleration, a, down the incline can be calculated from measurements of distances between dots on the tape. The value of the acceleration due to gravity, g, can then be determined from the relationship below.

$$\mathbf{a = g\sin\theta}$$

The diagram below represents a ticker tape, drawn to actual size, for the motion of the block down the plane. The frequency of the ticker timer was 50 Hz.

Assume that the value of g determined by this experiment is 9.8 ms^{-2}.

(a) What interval of time is represented between any two dots on the tape? [1]
(b) Find the velocity between the first two dots on the tape. [1]
(c) Find the velocity between the last two dots on the tape. [1]
(d) Use the results from parts (b) and (c) to help calculate the average acceleration of the block down the incline. [1]
(e) Find the value of 0 in this experiment. [1]
(f) Identify TWO significant sources of experimental error in the procedure outlined above and explain how these errors could be minimized. [4]

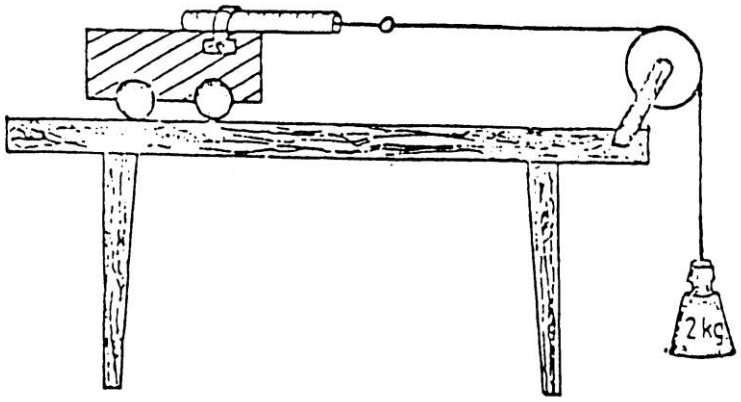
19. The acceleration and braking capabilities of a new car are being tested. The driver uniformly accelerates the car from rest at 7.0 ms^{-2} for 4.0 seconds. The car then travels at constant velocity for 2.0 seconds and then, by applying the brakes with an even pressure stops the car in 5.0 seconds.

(a) Draw up a set of velocity and time values for the journey in the table. [2]
(b) Plot the values tabulated in (a). [1]
(c) From the graph, determine the distance travelled by the car in the first 5 seconds. [1]
(d) Calculate the average velocity for the whole journey. [2]

20. A trolley of mass 3.0 kg rolled along a level frictionless surface. It had a constant speed of 6.0 m/s.
A block of mass m fell vertically into the trolley and remained in it. As a result of this collision the speed of the trolley decreased to 4.0 m/s.

(a) What is the value of mass m? [2]
(b) What is the total kinetic energy of the trolley and the block after the collision? [1]
(c) When the block fell into the trolley its vertical velocity was 5.0 m/s. Why was it not necessary to take this into account when finding the answer to part (a)? [1]

21. This question refers to the diagram below.



The trolley is fitted with a spring balance (calibrated in newtons). The total mass of the system (trolley, spring balance, string, and hanging mass) is 8.0 kg. The spring balance is connected to a light string whose mass can be ignored, which runs over a frictionless pulley. Any frictional forces on the table can be ignored.

(a) Find the acceleration of the trolley when it is released. [2]
(b) Find the reading on the spring balance while the system is accelerating. [1]

22. A defibrillator is a device medical personnel use to return out of control hearts to their normal rhythms. A defibrillator passes a 20.0 ampere current at 3.00×10^3 V through a patient's heart in about 5.0 milliseconds.

(a) How much electrical power does a defibrillator provide? [1]
(b) How much electrical energy passes through the patient's heart? [1]
(c) Convert your answer to part (b) into kilowatt hours. [1]
(d) What is the resistance of the patient's body in this circuit? [1]

23. (a) The metal dome on the van der Graaf generator can produce over 100 000 volts when it is charged. Why is it possible for a person to touch the charged dome without risk of serious injury? [1]

(b) Fuses and circuit breakers are two safety devices found in household circuits. Explain the importance of these devices and discuss the advantages of using circuit breakers rather than fuses in transformers commonly used in school laboratories. [2]

24. Outline the contribution of ONE of the following to our present understanding of electricity and/or magnetism. [2]

Volta, Galvani, Oersted, Ohm.

25. (a) Consider the following statements about four types of electromagnetic radiation A, B, C, and D.

I. Radiations A and B have frequencies higher than radiations C and D.

II. Radiation C cannot be detected by the human eye.

III. Radiation D has a lower penetrating ability than B.

IV. Radiation A does not come from the nucleus of atoms.

Each of the letters A to D correspond to either infrared rays, X-rays, gamma radiation, or visible light.

Match each letter with the correct radiation type. [2]

(b) Two different radio stations transmit their broadcasts at 660 kHz and 1320 Hz respectively. Find the ratio of:

(i) the velocities of the two waves as they travel through air. [1]
(ii) the wavelengths of the two waves as they travel through the air. [1]

(c) A fruit bat uses echo location to navigate in the dark. A hovering bat emitted an ultrasonic sound wave of frequency 20 kHz. A return wave reflected from a large tree was detected by the bat 0.50 seconds after the original wave was sent. If the speed of sound in air is 340 m/s, how far away was the tree from the bat when it emitted the original wave? [2]