SAASTA
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NATIONAL SCIENCE Olympiad

Past Examination Questions and Answers: Physics Section

2003

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PAST EXAMINATION QUESTIONS AND ANSWERS 2003: GENERAL KNOWLEDGE AND PHYSICS SECTIONS

SECTION A: GENERAL KNOWLEDGE

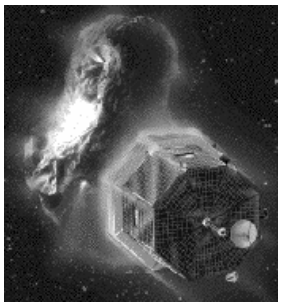
This section is meant to probe how well informed you are as a future scientist, in history, geography and science and its bearing on day to day life. IT REQUIRES violating the bounds of textbook platitude and READING EXTENSIVELY! The questions and answers come from a variety of sources: Textbooks, Encyclopaedias, and Newspapers. Some information was also obtained from various websites as well as from Lifestyle and Science magazines.

1 The CONTOUR space probe has recently been in the news because of a catastrophic mistake, which caused NASA to lose communication with it. What was the purpose of the space probe if the catastrophic mistake had not occurred? It was supposed to study

1 shrinking of the ozone layer
2 the sun from higher angles outside the general planetary plane
3 the Kuiper belt
4 Alfa Centauri (the star)
5 two or more comets

Answer (NASA)

Here is the story from which the question was set, as obtained from NASA's website



CONTOUR

Comet Encke

Comet Schwassmann-Wachmann

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Discovery Mission: Contour

The Comet Nucleus Tour, or CONTOUR, mission launched from Cape Canaveral on July 3, 2002. Six weeks later, on August 15, contact with the spacecraft was lost after a planned maneuver that was intended to propel it out of Earth orbit and into its comet-chasing solar orbit. Limited ground-based evidence at the time suggested the spacecraft split into several pieces. Attempts to contact CONTOUR were made through December 20, 2002, when NASA and The

Johns Hopkins University Applied Physics Laboratory concluded that the spacecraft was lost. NASA convened a CONTOUR Mishap Investigation Board with Theron Bradley Jr., NASA Chief Engineer, as chair. The purpose of the Board was to examine the processes, data and actions surrounding the events of August 15; to search for proximate and root causes; and develop recommendations that may be applicable to future missions. After an extensive investigation, the board identified four possible causes for the failure but concluded the probable proximate cause was structural failure of the spacecraft due to plume heating during the embedded solid-rocket motor burn. **Mission Objectives:** The CONTOUR mission was timed to encounter and study two very different comets, Encke and Schwassmann-Wachmann-3 as they made their periodic visits to the inner solar system. At each comet flyby, the spacecraft was to get as close as 60 miles (100 kilometers) to take high resolution pictures and perform a detailed compositional analyses of both gas and dust in the near-nucleus environment, as well as determine the comet's precise orbit.

The science objectives were to dramatically improve our knowledge of key characteristics of comet nuclei and to assess their diversity. **Mission Management:** The CONTOUR mission was managed for NASA by the Johns Hopkins University Applied Physics Laboratory in Laurel, MD.

The Principal Investigator was Dr. Joseph Veverka of Cornell University.

2 A very important safety system in modern cars is the ABS system. Why is this system so important?

1 It drastically decreases stopping distances because it prevents wheels from slipping.

2 It opens air bags when the car is in a collision

3 It allows the car to crumple in certain places without the passengers being hurt

4 It brakes the rear inner wheel in a curve so as to regain control of the car when it starts to slip

5 It improves lighting on the road to improve visibility

Answer (Wikipedia)

An anti-lock braking system (ABS) is a system on motor vehicles which prevents the wheels from locking while braking. The purpose of this is twofold: to allow the driver to maintain steering control under heavy braking and, in most situations, to shorten braking distances (by allowing the driver to hit the brake fully without the fear of skidding or loss of control). Disadvantages of the system include increased braking distances under certain conditions and the creation of a "false sense of security" among drivers who do not understand the operation and limitations of ABS. Since it came into widespread use in production cars (with "version 2" in 1978), ABS has made considerable progress. Recent versions not only handle the ABS function itself (i.e. preventing wheel locking) but also traction

control, BAS (Braking Assist System), anti-understeer ESP (Electronic Stability Program) and CBC (Cornering Brake Control), amongst others. Not only that, but from history at Bosch its version 8.0 system now weighs less than 1.5 kilograms, compared with 6.3 kg of version 2.0 in 1978.

3 The Bushveld is well known worldwide as an area of astronomical geological importance. This area is famous for its

1 Sedimentary rocks
2 Igneous rocks
3 Metamorphic rocks
4 Fold mountains
5 Active volcanoes

Answer (Wikipedia)

The Bushveld Igneous Complex contains some of the richest ore deposits on Earth. The reserves of chromium, platinum, palladium, osmium, iridium, rhodium, and ruthenium are the world's largest, and there are vast quantities of iron, tin, titanium, and vanadium. Dimension Stone is also quarried from parts of the Complex. The Complex includes layered mafic intrusions (the Rustenburg Layered Suite) and a felsic phase. It has its geographic centre located north of Pretoria in South Africa at about 25° S and 29° E. It covers over 66,000 km^2, an area the size of Ireland. The complex varies in thickness, sometimes reaching 9000 meters thick. Lithologies vary from largely ultramafic peridotite, chromitite, harzburgite, and bronzitite in the lower sections to mafic norite, anorthosite, and gabbro toward the top, and the mafic Rustenburg Layered Suite is followed by a felsic phase (the Lebowa Granite Suite). The origin of the vast complex is attributed to a series of huge arcuate differentiated lopolithic intrusions. The Lebowa Granite Suite has been dated at 2.054 billion years (2.054 Ga). The orebodies within the complex include the UG2 reef containing up to 43.5% chromite, and the platinum-bearing horizons Merensky Reef and Plat Reef. The Merensky Reef varies from 30 to 90 cm in thickness. It is a norite with extensive chromitite and sulfide layers or zones containing the ore. The *Reef* contains an average of 10 ppm platinum group metals in pyrrhotite, pentlandite, and pyrite as well as in rare platinum group minerals and alloys

4 Sishen in the Northern Cape is well known for mining of the mineral

1 Gold
2 Diamonds
3 Platinum
4 Iron ore
5 Granite

Answer (Wikipedia)

Sishen and the neighbouring town of Kathu are the iron ore capital of the Northern Cape. Kathu and the accompanying industrial area of Sishen came into being because of iron ore mining activity in the Kalahari — it has one of the five largest open-cast iron ore mining operations in the world. Some of the world's longest ore trains travel through harsh territory on the Sishen-Saldanha railway to offload their cargo at Saldanha Bay.

5 I am in a strange country. If I walk on a straight ahead, I will reach the Himalayas. If I turn left I will go to Burma. If I walk backwards, I will be on my way to Sri Lanka. If I turn left, I will reach Pakistan. In which country am I?

1 China
2 India
3 Afghanistan
4 Iran
5 Kuwait

Answer (CIA The World Factbook)

Carefully study the map below and try to locate yourself. The question was badly phrased and thus invalid! You cannot turn left and reach Pakistan and turn left and reach Burma (now called Myanmar). If you turn left and reach Pakistan and turn right and reach Burma, then you would be in India!

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6 The oldest dolomite caves in the world are in South Africa. They are also an international attraction.
These caves are the

1 Kango caves
2 Sudwala caves
3 Sterkfontein caves
4 Echo caves
5 Holkrans caves

Answer (Wikipedia)

The Cradle of Humankind is a World Heritage Site first named by Unesco in 1999, about 50 kilometres northwest of Johannesburg, South Africa.

This site currently occupies 183 square miles (474 km²); it contains a complex of limestone caves, including the Sterkfontein Caves, where the 2.3-million year-old fossil *Australopithecus africanus* (nicknamed "Mrs Ples") was found in 1947 by Dr Robert Broom and John Robinson. The find helped corroborate the 1924 discovery of the juvenile *Australopithecus africanus* skull, "Taung Child", by Raymond Dart, at Taung in the North West Province of South Africa. Excavations continue at the site to this day. In 1997, the near-complete *Australopithecus* skeleton of "Little Foot", dating to at least 3.3 million years ago, was discovered by University of Witwatersrand palaeoanthropologist Professor Ronald J. Clarke. The controlled use of fire at this site has been dated to over 1 million years ago at Swartkrans.

The hominid remains at the Cradle of Humankind were encased in a mixture of limestone and other sediments called breccia and fossilised over time. Hominids probably lived all over Africa, but their remains are only found at sites where conditions allowed for the formation and

preservation of fossils. On December 7, 2005, President Thabo Mbeki opened a new visitor's centre, Maropeng, at the site.

7 During September/October 2002 half a million people were advised to flee form certain cities in Louisiana and Texas. They had to escape the

1 tropical cyclone Daimonia
2 an earthquake registering 7.5 on the Richter scale
3 the hurricane Lili
4 a series of tornadoes
5 a typhoon

Answer (Wikipedia)

Hurricane Lili was a powerful hurricane during the 2002 Atlantic hurricane season that caused damage across the Caribbean and into Louisiana. The storm was initially categorized as a tropical depression on September 21, and made its final landfall on October 4. Lili was responsible for 14 direct deaths and large amounts of property damage. Lili formed as a tropical depression on September 21 about 900 nm east of the Windward Islands. The depression moved rapidly westward and developed into a tropical storm. It crossed the Windward Islands on the 24th. Its development was short-lived, and Lili degenerated to a tropical wave the next day.

8 The malaria problem in South Africa has increased alarmingly in the past few years. The government has started to work with neighbouring countries to try and solve the problem and the infection in, for instance, KwaZulu-Natal has decreased drastically during 2002. The success is due to

1 the draining of marshes in northern KwaZulu-Natal
2 the use of the controversial insecticide DDT
3 the importation of a fish species that eats the mosquito larvae
4 the resettlement of the population in malaria-free areas
5 the development of a successful new vaccine

Answer (The Independent OnLine)

September 19 2006 at 12:44AM.

The health ministry on Monday welcomed the World Health Organisation's (WHO) endorsement of DDT in the fight against malaria. "South Africa is one of the few countries that supported and continued to use DDT (dichloro-diphenyl-trichloroethane) to address malaria affecting at least three of our nine provinces - KwaZulu-Natal, Limpopo and Mpumalanga," spokesperson Sibani Mngadi said in a statement. Mainly because of the re-introduction of the use of DDT, the country had managed to reduce the number of malaria cases from 64 868 in 2000 to 7 754 in 2005. The incidence of malaria had decreased from 15 per 10 000 people in 2000 to two per 10 000 in 2005 in malaria-affected areas, he said. He said the health ministry was concerned about the environmental impact of DDT, but was taking precautions.

"We are definitely worried, that's why we pay particular attention to the people who do the spraying, and ensure that the cleaning of equipment is done in a controlled way and to avoid spillage, that's also why it's restricted to indoor use," Mngadi said. Quoting from a WHO statement, Mngadi said the "correct and timely" use of indoor residual spraying (IRS) could reduce malaria transmission by up to 90 percent. According to the United States' Centres for Disease Control and Prevention website, IRS involved coating the walls and other surfaces of a house with a residual insecticide. For several months, the insecticide would kill mosquitoes and other insects that came in contact with these surfaces. IRS usually killed mosquitoes after they had fed, once they come to rest on the sprayed surface, preventing the transmission of infection to others. To be effective, it usually had to be applied to more than 70 percent of households in an area. - Sapa

9 A river in Southern Africa, which does not debouch into the sea is the

1 Limpopo
2 Breë
3 Kuiseb
4 Tugela
5 Okavango

Answer (Wikipedia)

The Limpopo River rises in the interior of Africa, and flows generally eastwards towards the Indian Ocean. It is around 1,600 kilometers long (or 1,770 km according to another source). The Limpopo is the second largest river in Africa that drains to the east after Zambezi River. The Limpopo River flows in a great arc, first zig-zagging northeast and north, then turning east and finally southeast. Then it serves as a border for about 640 kilometres, separating South Africa on the southeast bank from Botswana in the northwest and Zimbabwe on the north. There are several rapids as the river falls off Southern Africa's interior escarpment.

The Tugela River (also known as Thukela) is the largest river in KwaZulu-Natal Province, South Africa. The river originates in the Drakensberg Mountains, Mont-aux-Sources, (itself the source of tributaries of two other major South African rivers, the Orange River and the Vaal River) and plunges 947 metres down the Tugela Falls. From the Drakensberg range the river meanders for 520 km through the KwaZulu-Natal midlands before flowing into the Indian Ocean. The total catchment area is approximately 29,100 km². Land uses in the catchment are mainly rural subsistence farming and commercial forestry.

The Okavango River is a river in southwest Africa. It is the fourth-longest river system in southern Africa, running southeastward for 1,600km (1,000 miles). It begins in Angola, where it is known as the Cubango River. Further south it forms part of the border between Angola and Namibia, and then flows into Botswana, draining into the Moremi Wildlife Reserve. Before it enters Botswana, the river drops 4 meters, across the full 1.2km-width of the river, in a series of rapids known as Popa Falls, visible when the river is low, as during the dry season. Unusually, the Okavango does not have an outlet in the sea. Instead, it empties into a swamp in the Kalahari Desert, known as the

Okavango Delta. Part of the river's flow fills Lake Ngami. World famous for its remarkable wildlife, the Okavango area contains the Moremi Wildlife Reserve (Botswana).

The Kuiseb River in Namibia is bordered on one side by the tallest sand dunes in the world, and on the other by barren rock. The red sand dunes south of the river reach heights over 150 meters. The prevailing winds blow the dunes northward, but their movement is blocked by the river. In the process, so much sand and silt is deposited in the Kuiseb that it only reaches the sea while it is in flood.

10 An extinct animal formerly found in South Africa is the

1 Civet cat
2 White rhinoceros
3 Cape quagga
4 Bontebok
5 Scaly anteater

Answer (Wikipedia)

The quagga is an extinct subspecies of the plains zebra, which was once found in great numbers in South Africa's Cape Province and the southern part of the Orange Free State. It was distinguished from other zebras by having the usual vivid marks on the front part of the body only. In the mid-section, the stripes faded and the dark, inter-stripe spaces became wider, and the hindquarters were a plain brown. The name comes from a Khoikhoi word for *zebra* and is onomatopoeic, being said to resemble the quagga's call.

11 The coffee plant (*Coffea arabica*) of which the seeds are used to make coffee, originally comes from

1 Turkey
2 Arabia
3 Brasilia
4 Ethiopia
5 Asia

Answer (Wikipedia)

Coffee is a widely consumed beverage prepared from the roasted seeds—commonly called "beans"—of the coffee plant. Coffee was first consumed as early as the 9th century, when it was discovered in the highlands of Ethiopia. From Ethiopia, it spread to Egypt and Yemen, and by the 15th century had reached Persia, Turkey, and northern Africa. From the Muslim world, coffee spread to Italy, then to the rest of Europe and the Americas. Today, coffee is one of the most popular beverages worldwide.

The two most commonly grown species of the coffee plant are *Coffea canephora* and *C. arabica*, which are cultivated in Latin America, Southeast Asia, and Africa. Coffee berries are picked, processed, and dried. The seeds are roasted at temperatures around 200 °C (392 °F), during which the sugars in the bean caramelize, the bean changes color, and the flavor develops. The beans are roasted to a light, medium, or dark brown color, depending on the desired flavor. The roasted beans are ground and brewed in order to create the beverage coffee.

12 The 0 º longitude goes through

1 Washington DC
2 the Great Pyramids of Egypt
3 Ecuador
4 **Greenwich Observatory in London**
5 Paris in France

Answer (Wikipedia)

Refer to the map below.

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Longitude is the east-west geographic coordinate measurement most commonly utilized in cartography and global navigation. The Greek letter λ (lambda),[1][2] describes the location of a place on Earth east or west of a north-south line called the Prime Meridian. Longitude is given as an angular measurement ranging from 0° at the Prime Meridian to +180° eastward and −180° westward. Unlike latitude, which has the equator as a natural starting position, there is no natural starting position for longitude. Therefore, a reference meridian had to be chosen. In 1884, the International Meridian Conference adopted the Greenwich meridian as the *universal prime meridian* or *zero point of longitude*. Each degree of longitude is further sub-divided into 60 minutes, each of which divided into 60 seconds.

13 Two well-known scientists invented calculus in the last half of the seventeenth century, independent of each other. They were

1 Leibniz and Descartes
2 Newton and Leibniz
3 Newton and Riemann
4 Leibniz and Riemann
5 Pythagoras and Euclid

Answer (Encyclopaedia Britannica)

Calculus is a branch of mathematics concerned with the calculation of instantaneous rates of change (differential calculus) and the summation of infinitely many small factors to determine some whole (integral calculus). Two mathematicians, Isaac Newton of England and Gottfried Wilhelm Leibniz of Germany, share credit for having independently developed the calculus in the 17th century. Calculus is now the basic entry point for anyone wishing to study physics, chemistry, biology, economics, finance, or actuarial science. Calculus makes it possible to solve problems as diverse as tracking the position of a space shuttle or predicting the pressure building up behind a dam as the water rises. Computers have become a valuable tool for solving calculus problems that were once considered impossibly difficult.

14 What is the minimum number of colours needed on a map to always colour the adjoining regions in different colours?

1	3
2	**4**
3	5
4	6
5	7

Answer (Encyclopaedia Britannica)

Called the four-colour map problem, this is a problem in topology, originally posed in the early 1850s and not solved until 1976, that required finding the minimum number of different colours required to colour a map such that no two adjacent regions (i.e., with a common boundary segment) are of the same colour. Three colours are not enough, since one can draw a map of four regions with each region contacting the three other regions. It had been proved mathematically by the English attorney Alfred Bray Kempe in 1879 that five colours will always suffice; and no map had ever been found on which four colours would not do. As is often the case in mathematics, consideration of the problem provided the impetus for the discovery of related results in topology and combinatorics. A similar problem had been solved for the seemingly more complicated situation of a map drawn on a torus (doughnut-shaped surface), where seven colours were known to be the minimum. The four-colour problem was solved in 1977 by a group of mathematicians at the University of Illinois, directed by Kenneth Appel and Wolfgang Haken, after four years of unprecedented synthesis of computer search and theoretical reasoning. Appel and Haken created a catalog of 1,936 “unavoidable” configurations, at least one of which must be present in any graph, no matter how large. Then they showed how each of these configurations could be reduced to a smaller one so that, if the smaller one could be coloured with four colours, so could the original catalog configuration. Thus, if there were a map that could not be coloured with four colours, they could use their catalog to find a smaller map that also could not be four-coloured, and then a smaller one still, and so on. Eventually this reduction process would lead to a map with only three or four regions that, supposedly, could not be coloured with four colours. This absurd result, which is derived from the hypothesis that a map requiring more than four colours might exist, leads to the conclusion that no such map can exist. All maps are in fact four-colourable.

The strategy involved in this proof dates back to the 1879 paper of Kempe, who produced a short list of unavoidable configurations and then showed how to reduce each to a smaller case. Appel and Haken replaced Kempe's brief list with their catalog of 1,936 cases, each involving up to 500,000 logical options for full analysis. Their complete proof, itself several hundred pages long, required more than 1,000 hours of computer calculations.

The fact that the proof of the four-colour problem had a substantial component that relied on a computer and that could not be verified by hand led to a considerable debate among mathematicians about whether the theorem should be considered “proved” in the usual sense. In 1997 other mathematicians reduced the number of unavoidable configurations to 633 and made some simplifications in the argument, without, however, completely eliminating the computer portion of the proof. There

remains some hope for an eventual “computer-free” proof.

15 Where can two-thirds of all river water in the world be found?

1 The Congo-basin
2 The Mississippi-basin
3 The Nile valley
4 The Amazon-basin
5 The Victoria lake

Answer (Encyclopaedia Britannica)

The vast Amazon basin (Amazonia), the largest lowland in Latin America, has an area of about 2.3 million square miles (6 million square kilometres) and is nearly twice as large as that of the Congo River, the Earth's other great equatorial drainage system. Stretching some 1,725 miles from north to south at its widest point, the basin includes the greater part of Brazil and Peru, significant parts of Colombia, Ecuador, and Bolivia, and a small area of Venezuela; roughly two-thirds of the Amazon's main stream and by far the largest portion of its basin are within Brazil. The Tocantins-Araguaia catchment area in Pará state covers another 300,000 square miles. Although considered a part of Amazonia by the Brazilian government and in popular usage, it is technically a separate system. It is estimated that about one-fifth of all the water that runs off the Earth's surface is carried by the Amazon. The flood-stage discharge at the river's mouth is about 6,180,000 cubic feet (175,000 cubic metres) per second, which is four times that of the Congo and more than 10 times the amount carried by the Mississippi River. This immense volume of fresh water dilutes the ocean's saltiness for more than 100 miles from shore.

16 Which one of the following is, by definition, not a nut?

1 cashew
2 peanut
3 pecan
4 almond
5 macadamia

Answer (Encyclopaedia Britannica)

Cashew (*Anacardium occidentale) is* the characteristically curved, edible seed or nut of the domesticated cashew tree. The tropical and subtropical evergreen shrub or tree is native to the New World, but commercially cultivated mainly in Brazil and India. The nut, rich in oil and distinctively flavoured, is a commonly used ingredient in South and Southeast Asian cuisine, and it is a characteristic ingredient of numerous chicken and vegetarian dishes of southern India. In Western countries it is eaten mainly as a premium-quality snack food. The cashew tree produces wood that is useful in local economies for such practical items as shipping crates, boats, and charcoal (and also for a gum that it produces that is similar to gum arabic), but most cultivation is directed toward production of the valuable nut crop.

A groundnut is any of several plants that bear edible fruit or other nutlike parts. Three are members of the family Fabaceae (or Leguminosae): *Arachis hypogaea*, the peanut (*q.v.*), the fruit of which is a legume or pod rather than a true nut; *Apois*

americana, also called wild bean and potato bean, the tubers of which are edible; and *Lathyrus tuberosa*, also called earth-nut pea. *Cyperus esculentus*, nut sedge or yellow nut grass, is a papyrus relative (family Cyperaceae) that also bears edible tubers, especially in the variety called chufa or earth almond.

Pecan *(Carya illinoinensis,* or *illinoensis*), nut and tree of the walnut family (Juglandaceae), native to temperate North America. The tree occasionally reaches a height of about 50 m (160 feet) and a trunk diameter of 2 m. It has a deeply furrowed bark and compound leaves with 9–17 finely toothed leaflets, arranged in feather fashion. Rich and distinctive in flavour and texture, the pecan has one of the highest fat contents of any vegetable product and a caloric value close to that of butter. Its production is the basis of a considerable industry in the southeastern United States. The pecan may be eaten raw, sweetened or salted. It is widely used in pastries, such as coffee cakes, and often in conjunction with chocolate. In the southeastern United States the pecan pie, consisting of pecans baked in a clear custard, and the pecan praline candy are traditional sweets.

Almond (*Prunus dulcis*), is a tree native to southwestern Asia and its edible seed, or nut. The nuts are of two types, sweet and bitter. Sweet almonds are the familiar edible type consumed as nuts and used in cooking or as a source of almond oil or almond meal. The almond tree, growing somewhat larger than the peach and living longer, is strikingly beautiful when in flower. The growing fruit resembles the peach until it approaches maturity; as it ripens, the leathery outer covering, or hull, splits open, curls outward, and discharges the nut.

Macadamia is any of about 10 species of ornamental evergreen tree belonging to the family Proteaceae, producing an edible, richly flavoured dessert nut. Macadamias originated in the coastal rain forests and scrubs of what is now Queensland in northeastern Australia. The macadamias grown commercially in Hawaii and Australia are principally of two species, the smooth-shelled *Macadamia integrifolia* and the rough-shelled *M. tetraphylla*; the two tend to hybridize beyond distinction, and trees grown as *M. ternifolia* are usually one of these two species. Because of the successes of the Hawaiian nut industry, other subtropical regions have planted macadamia orchards. Large acreages are planted in South Africa, Zimbabwe, and Malawi and parts of South and Central America. Because it is difficult to tell precisely when the nut is ripe, the macadamias are not harvested until they drop to the ground. The mature nuts are then gathered by hand and machine-hulled, dried, and stored for processing. In Hawaiian factories, the nuts are roasted, usually in oil, salted, and packed. Some of the crop is used by bakers in confections. The nuts are a good source of calcium, phosphorus, iron, and vitamin B; they contain 73 percent fat. Because macadamias are difficult to propagate, slow to bear, and limited in range of cultivability, production has not kept pace with increased demand, thus rendering the product costly.

17 Which of the following mountains are **not** parts of the South African escarpment?

1 Nuweveldt
2 Drakensberg
3 Roggeveldt
4 Soutpansberg
5 Sneeu

Answer (Wikipedia)

The great escarpment is the plateau edge of southern Africa that separates the region's highland interior plateau from the fairly narrow coastal strip. It lies predominantly within the Republic of South Africa and Lesotho but extends northeastward into eastern Zimbabwe (where it separates much of that country from Mozambique) and northwestward into Namibia and Angola (where it separates the central plateaus of those countries from their arid coastal plains). The Great Escarpment has generally been formed by the headwater erosion of rivers of the coastal plain. The escarpment is sharply defined or rather indistinct depending on whether the plateau edge rocks are hard-overlying-soft or are of undifferentiated hardness. The boldest part of the escarpment is in a section of the Drakensberg along the border of Lesotho and KwaZulu/Natal province, South Africa, where basalt lavas distinctly overlie soft sandstones. The Drakensberg, the main mountain range in South Africa, rises to more than 11,400 feet (3,475 metres) and extends roughly northeast to southwest for 700 miles (1,125 km) parallel to the southeastern coast of South Africa. Rock and cave art several thousands of years old has been found in the range. There are many game reserves and parks. In 2000 uKhahlamba/Drakensberg Park was designated a UNESCO World Heritage site. The Drakensberg is part of the Great Escarpment and separates the extensive high plateaus of the South African interior from the lower lands along the coast. From its northeastern termination in Limpopo and Mpumalanga provinces, the range extends through Lesotho to Eastern Cape province. The range separates Mpumalanga and Free State provinces and Lesotho on the plateau from lower-lying Swaziland and KwaZulu-Natal province near the coast. The Drakensberg is the main watershed of South Africa and is the source of the Orange River.

The Roggeveld Mountains (Roggeveldberge) are a mountain range in South Africa and lies between the towns of Calvinia and Sutherland, east and northeast of Tankwa Karoo National Park. The mountains receive about 200mm of rainfall in a normal year. The name "Roggeveld" came from wild rye which was once plentiful in the area. The Ouberg Pass crosses the range at an altitude of 1,404 meters. Sutherland, in the western part of the range, is one of the coldest places in South Africa.

The Soutpansberg (Afrikaans, "Salt Pan Mountain") is a range of mountains in the north of South Africa, named for the salt pan located at its western end.

18 When some fireworks explode a lovely rain of little red lights follows. Where does the red colour come from? A little bit of salt of a certain alkali metal is added to the fireworks; which one?

1 Lithium
2 Sodium
3 Potassium
4 Rubidium
5 Caesium

Answer (Encyclopaedia Britannica)
Fireworks are explosives or combustibles used for display. Of ancient Chinese origin, fireworks evidently developed out of military rockets and explosive missiles, and they were (and still are) used in elaborate combinations for celebrations. During the European Middle Ages, fireworks accompanied the spread of military explosives westward, and in Europe the military fireworks expert was pressed into service to conduct pyrotechnic celebrations of victory and peace. In the 19th century, the introduction of new ingredients such as magnesium and aluminum greatly heightened the brilliance of such displays.

There are two main classes of fireworks: force-and-spark and flame. In force-and-spark compositions, potassium nitrate, sulfur, and finely ground charcoal are used, with additional ingredients that produce various types of sparks. In flame compositions, such as the stars that are shot out of rockets, potassium nitrate, salts of antimony, and sulfur may be used. For coloured fire, potassium chlorate or potassium perchlorate is combined with a metal salt that determines the colour. The most popular form of firework, the rocket, is lifted into the sky by recoil from the jet of fire thrown out by its burning composition; its case is so designed as to produce maximum combustion and, thus, maximum thrust, in its earliest stage.

19 The first atomic bomb exploded on 16 July 1945 in New Mexico. The second and third bombs exploded on Hiroshima and Nagasaki in August, the same year. The name of the third bomb was

1 A-Bomb III
2 Eagle
3 Fat Man
4 Mars Project
5 Broken Arrow

Answer (Encyclopaedia Britannica)
The first atomic bombs were built in the United States during World War II under a program called the Manhattan Project. One bomb, using plutonium, was successfully tested on July 16, 1945, at a site 193 km (120 miles) south of Albuquerque, New Mexico in what was called the Trinity Test. The first atomic bomb to be used in warfare used uranium. Code-named Little Boy, It was dropped by the United States on Hiroshima, Japan, on August 6, 1945. The explosion, which had the force of more than 15,000 tons of TNT, instantly and completely devastated 10 square km (4 square miles) of the heart of this city of 343,000 inhabitants. Of this number, 66,000 were killed immediately and 69,000 were injured; more than 67 percent of the city's structures were destroyed or damaged.
The next atomic bomb, code-named Fat Man, was of the plutonium type; it was dropped on Nagasaki on August 9, 1945, producing a blast equal to 21,000 tons of

TNT. The terrain and smaller size of Nagasaki reduced destruction of life and property, but 39,000 persons were killed and 25,000 injured; about 40 percent of the city's structures were destroyed or seriously damaged. The Japanese initiated surrender negotiations the next day.

20 A dam has very little water. Each day the volume of the water doubles. On the fifth day the dam is 50% full. On which day will the dam be full? On day

1 10
2 9
3 8
4 7
5 6

Answer 5

If the dam's volume doubles every 24 hours and it is 50% full on the fifth day, in another 24 hours (i.e., on day 6!) its volume will be
2 × 50% = 100%

21 "When a man sits next to a very pretty girl for an hour, it feels like a minute. But let him sit on a hot stove for a minute – then it is longer than any hour. That is relative!" Who said that?

1 Isaac Newton
2 Max Planck
3 Albert Einstein
4 Thomas Edison
5 Benjamin Franklin

Answer (Encyclopaedia Britannica)

With his theories of special relativity (1905) and general relativity (1916), Einstein overthrew many assumptions underlying earlier physical theories, redefining in the process the fundamental concepts of space, time, matter, energy, and gravity. Along with quantum mechanics, relativity is central to modern physics. In particular, relativity provides the basis for understanding cosmic processes and the geometry of the universe itself.

"Special relativity" is limited to objects that are moving at constant speed in a straight line, which is called inertial motion. Beginning with the behaviour of light (and all other electromagnetic radiation), the theory of special relativity draws conclusions that are contrary to everyday experience but fully confirmed by experiments. Special relativity revealed that the speed of light is a limit that can be approached but not reached by any material object; it is the origin of the most famous equation in science, $E = mc^2$; and it has led to other tantalizing outcomes, such as the "twin paradox."

"General relativity" is concerned with gravity, one of the fundamental forces in the universe. (The others are electricity and magnetism, which have been unified as electromagnetism, the strong force, and the weak force.) Gravity defines macroscopic behaviour, and so general relativity describes large-scale physical phenomena such as planetary dynamics, the birth and death of stars, black holes, and the evolution of the universe.

Special and general relativity have profoundly affected physical science and human existence, most dramatically in applications of nuclear energy and nuclear weapons. Additionally, relativity and its rethinking of the fundamental categories of space and time have provided a basis for certain philosophical, social, and artistic interpretations that have influenced human culture in different ways.

22 Hubble's constant gives the

1 time that has passed since the big bang
2 speed at which nebulae move through space
3 rate at which the universe expands
4 rate at which a solar system moves through space
5 rate at which the speed of the solar systems that are moving away, changes

Answer (Encyclopaedia Britannica)

Hubble's constant, in cosmology, is a constant of proportionality in the relation between the velocities of remote galaxies and their distances. It expresses the rate at which the universe is expanding. It is denoted by the symbol *H* and named in honour of Edwin Hubble, the American astronomer who attempted in 1929 to measure its value. With redshifts of distant galaxies measured by Vesto Slipher, also of the United States, and with his own distance estimates of these galaxies, Hubble established the cosmological velocity-distance law:

velocity = *H* ´ distance.

According to this law, known as the Hubble law, the greater the distance of a galaxy, the faster it recedes. Derived from theoretical considerations and confirmed by observations, the velocity-distance law has made secure the concept of an expanding universe. Hubble's original value for *H* was 150 km (93 miles) per second per 1,000,000 light-years. Modern estimates, using more precise distance measurements, place the value of *H* at between 15 and 30 km (9.3 and 18.6 miles) per second per 1,000,000 light-years. The reciprocal of Hubble's constant lies between 10 billion and 20 billion years, and this cosmic time scale serves as an approximate measure of the age of the universe.

23 The modern wristwatch is very accurate. The reason for this is

1 the quartz crystal
2 modern microprocessor technology
3 hands with extremely small mass
4 low inertia components
5 very small caesi counters

Answer (Wikipedia)

A *movement* in watch-making is the mechanism that measures the passage of time and displays the current time (and possibly other information including date, month and day). Movements may be entirely mechanical, entirely electronic (potentially with no moving parts), or a blend of the two. Most watches intended mainly for

timekeeping today have electronic movements, with mechanical hands on the face of the watch indicating the time.

Electronic movements have few or no moving parts. Essentially, all modern electronic movements use the piezoelectric effect in a tiny quartz crystal to provide a stable time base for a mostly electronic movement: the crystal forms a quartz oscillator which resonates at a specific and highly stable frequency, and which can be used to accurately pace a timekeeping mechanism. For this reason, electronic watches are often called *quartz watches.* Most quartz movements are primarily electronic but are geared to drive mechanical hands on the face of the watch in order to provide a traditional analog display of the time, which is still preferred by most consumers.

24 Recently, an object from outer space was caught by the earth's gravitational field and it is now in orbit around the earth. The object was named J002E3. What do scientists suspect this object is?

1 A comet
2 An asteroid
3 The primary sun panel of the NIR space station
4 The third stadium of the Apollo 12
5 A piece of wreckage from the Challenger that exploded

Answer (Wikipedia)

J002E3 is the designation given to a supposed asteroid discovered by amateur astronomer Bill Yeung on September 3, 2002. Further examination revealed the object was not a rock asteroid but instead the S-IVB third stage of the Apollo 12 Saturn V rocket. When it was first discovered it was quickly found that the object was in an orbit around Earth. Astronomers were surprised at this as the Moon is the only large object in orbit around the Earth and anything else would have been ejected long ago due to perturbations with the Earth, the Moon and the Sun. Therefore it must have entered into Earth orbit very recently, yet there was no recently-launched spacecraft that matched the orbit of J002E3.

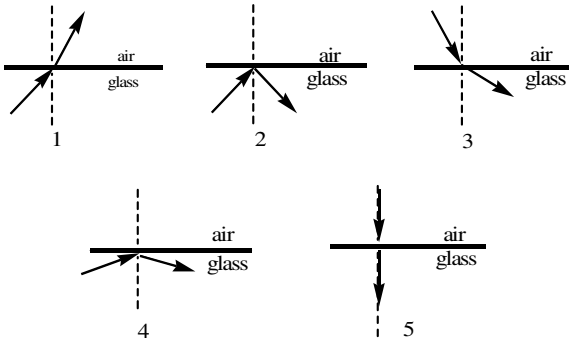
One explanation could have been that it was a 30-metre wide piece of rock, but University of Arizona astronomers found that the object's electromagnetic spectrum was consistent with white titanium dioxide paint, the same paint used by NASA for the Saturn V rockets. Back-tracing its orbit showed that the object had been orbiting the Sun for 31 years and had last been in the vicinity of the Earth in 1971. This seemed to suggest that it was a part of the Apollo 14 mission but NASA knew the whereabouts of all hardware used for this mission; the third stage, for instance, was deliberately crashed into the Moon for seismic studies. The only other explanation was that it was the S-IVB third stage for Apollo 12. NASA had originally planned to direct the S-IVB into a solar orbit, but an extra long burn of the ullage motors meant that venting the remaining propellant in the tank of the S-IVB

did not give the rocket stage enough energy to escape the Earth-Moon system, and instead the stage ended up in a semi-stable orbit around the Earth after passing by the Moon in November 18, 1969. The Apollo 12 S-IVB eventually vanished. It is thought that J002E3 left Earth orbit in June, 2003, and that it may return to orbit the Earth in about 2032.

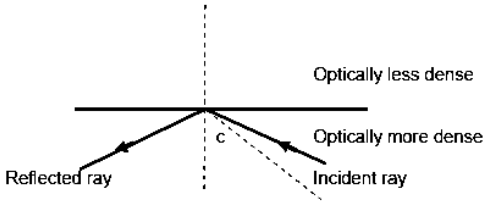
SECTION B: PHYSICS

1 Below are the paths of five light rays. Which one is correct?

2



Answer 4 shows the correct light rays which are totally internally reflected.



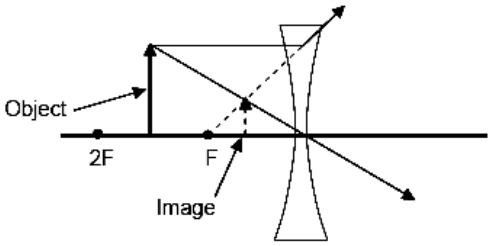
2 When an object is placed between F and 2F before a biconcave lens, the image is

1 behind the lens, enlarged, behind 2F, upside down and real
2 behind the lens, reduced, between F and 2F and upside down
3 behind the lens, same size, on 2F and real
4 on the same side of the lens, reduced, upright and not real
5 on the same side of the lens, upright, enlarged, behind the object and not real

	FREQUENCY	AMPLITUDE
1	high	big
2	high	small
3	low	small
4	low	big
5	average	big

Answer 4

The image is on the same side as the object, diminished (smaller) and is virtual (not real



3 Which one of the following apparatus functions according to Fleming's left hand rule?

1 Dynamo
2 Transformer
3 Electric motor
4 Electro-magnet
5 Electric bell

Answer 3

If your thumb, forefinger and index fingers are held so that they are at right angles to each other, then the **left** hand **motor** rule applies. Here the **thumb** represents the **force** experienced by the **current** carrying conductor (**index** finger) in a magnetic **field** (**fore** finger).

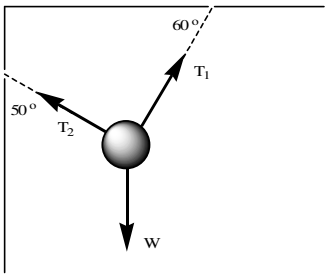
This is not in contradiction to the right hand generator rule: one is a consequence of the other. In other words, in one case the conductor is forced to move (motor) and in the other the moving conductor generates a current (dynamo) and by Lenz's Law these two are in opposite directions.

4 You are listening to a soprano singing very high and very loud. Which one of the following best describes the wave because of her voice?

Answer 1

A "high" note is one with a higher frequency than a "low". A "loud" sound has a larger amplitude that a "quieter" sound. So a high loud sound would need a high frequency and a big amplitude.

5 Three forces keep an object in equilibrium as illustrated in the vector diagram below.



Which one of the following equations is correct for this equilibrium?

1 $T_1\cos 60º - T_2\cos 50º = 0$
2 $T_1\cos 60º - T_2\cos 40º = 0$
3 $T_1\sin 60º + T_2\sin 40º = 0$
4 $T_1\sin 60º - T_2\cos 50º = 0$
5 $T_1\sin 60º + T_2\sin 50º - W = 0$

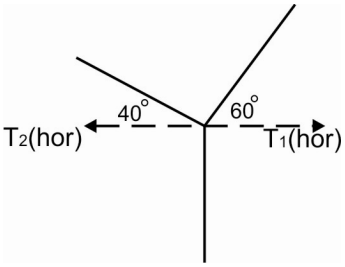
Answer 2

If the forces are resolved horizontally then:

$$T_2 \cos 40^o = T_1 \cos 60^o$$

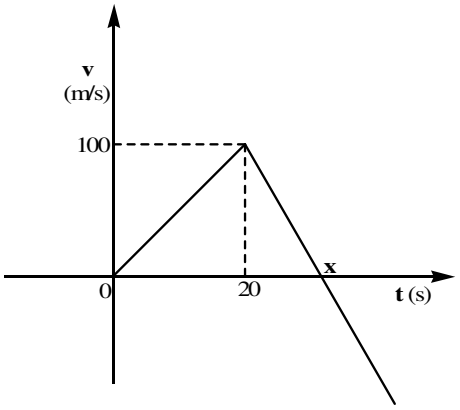
or

$$T_2 \cos 40^o - T_1 \cos 60^o = 0$$



The following information is for use in answering the next three multiple-choice questions:

The velocity-time graph below describes the motion of a rocket accelerating upwards from rest. After a certain time the engines are cut.



6 What happens to the rocket at time **x**? It is the moment when the

1 engine is cut
2 acceleration of the rocket becomes zero
3 rocket starts moving down
4 rocket hits the ground
5 rocket reaches constant velocity

Answer 3

The rocket accelerates upwards whilst the engine is on. The moment the engine is cut (turned off at Y) the rocket will decelerate at –g until its vertical speed is zero (at X) after which it has an increasing negative speed.

7 What is the value of time **x** on the graph?

1 25 s
2 30 s
3 35 s
4 40 s
5 50 s

Answer 2

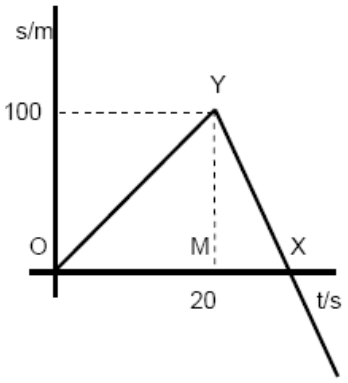
Using the equation v = u + at we get that:

$a = v/t$ since (u = 0)

or

$a = 100/20 = 5\ m.s^{-2}$

From the moment the rocket's engine is cut it decelerates at $-10\ m.s^{-2}$ (from Y to X): twice that from O to Y. This means that time from O to Y is twice that from Y to X. So the time from Y to X is 10 seconds, so OX is 30 seconds.



8 At what time did the rocket reach half of its maximum height?

1 10 s
2 15 s
3 17.32 s
4 17.5 s
5 86.6 s

Answer 3

The total displacement is equal to areas

OMY + YMX.

OMY = 100 x 20 x ½ = 1000 m,

and

YMX = 100 x 10 x ½ = 500 m.

So displacement = 1 500 m. Half of this is 750 m, which before the rocket reaches Y. Using the equation

$s = ut + \frac{1}{2}at^2$

or

$t^2 = 2s/a$ (since u = 0)

so $t = \sqrt{(2s/a)}$

now s = 750 m and a = 5 $m.s^{-2}$

Substituting this we get:

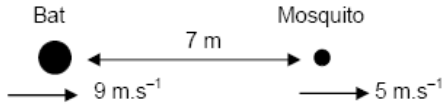
t = √(2 x 750/5) = √300 = 17.32 seconds

9 A bat flies in a straight, horizontal trajectory behind a mosquito. On the same instant that the mosquito is exactly 7 m before the bat, the bat is flying at 9 m/s and the mosquito at ? m/s. How long will it take the bat to overtake the mosquito?

1 0.78 s
2 1.29 s
3 1.75 s
4 1.4 s
5 0.54 s

Answer 3

Cannot answer the question since the mosquito's speed is not given. However, working backwards it would appear that either 4 or 5 $m.s^{-1}$ would provide a reasonable answer. Certainly answers 1 and 5 are impossible, as the mosquito is going faster than the bat! So assuming the mosquito flies at 5 $m.s^{-1}$ we have:



This means that the bat is catching the mosquito at 9 – 5 = 4 $m.s–1$

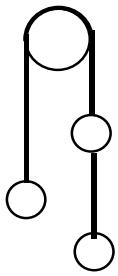
Speed = distance/time

so

time = distance/speed

= 7/4 = 1.75 seconds.

10 Three objects, each with mass 2 kg, are hanging from lightweight strings over a frictionless pulley as shown in the diagram. The magnitude of the acceleration of the system is **a**.



Another two identical objects are added to the system, one each side. The magnitude of the acceleration of the system is now

1 0.6**a**
2 1.5**a**
3 1.67**a**
4 6**a**
5 6.67**a**

Answer 1

For the system given the acceleration is:

4g – T = 4a and

T – 2g = 2a

So 2g = 6a or a = g/3

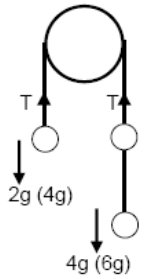
When another mass is added to each side the above become:

6g – T = 6a' and

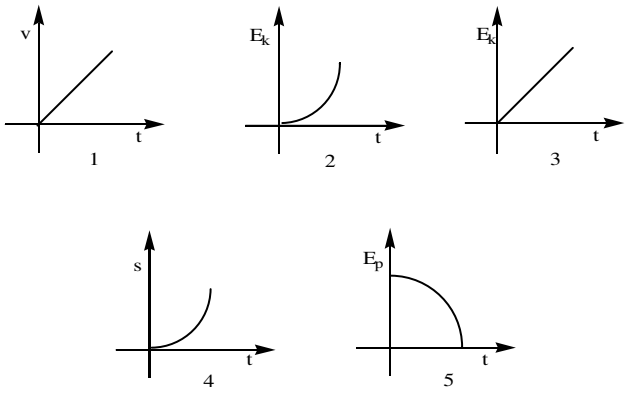
T – 4g = 4a'

So 2g = 10a or a' = g/5

This means that a'/a = (g/5)/(g/30) = 0.6 and so a' = 0.6a



11 Which one of the following graphs is not correct for an object falling freely from rest?



Answer 3

For a freely falling body v is proportional to t (v = u + at). Graph 1 shows this. Correct

For a freely falling body E_K is proportional to t^2 Graph 2 shows this. Correct

For a freely falling body E_K is proportional to t^2 Graph 3 shows E_K proportional to t. **Not correct**

For a freely falling body s is proportional to t^2. Graph 4 this. Correct

For a freely falling body E_P is a maximum to start with. It then speeds up as it falls, losing E_P faster and faster till it hits the ground. There is a relationship between E_P and t^2 and graph 5 shows this. Correct.

Note. Sometimes when answering Multiple Choice questions it is quite quick to spot the right answer. This question is a good example of this. There are two graphs (2 & 3) with the same axes but different graphs – both cannot be correct so just look at those two and decide!

12 The weight of a man on earth is 700 N. He travels through space to a planet where his weight is still 700 N. The radius of the planet is half of that of the earth. What is the mass of the planet?

1 4× bigger than that of the earth
2 2× bigger than that of the earth
3 The same as that of the earth
4 Half of that of the earth
5 A quarter of that of the earth

Answer 5

Using Newton's Law of Universal Gravitation:

$$F = GmM/(r^2)$$

Substituting we get:

$$700 = GmM/(r^2) \text{ for Earth.}$$

On the distant planet we get

$$700 = GmM'/(r^2/4),$$

Since $R = \frac{1}{2} r$ so $R^2 = r^2/4$

Then $GmM/r^2 = 4GmM'/r^2$

This means that $M = 4M'$

or that the mass of the distant planet

$$M' = M/4$$

13 An object is in equilibrium when

A the resultant force on the object is zero
B the acceleration of the object is zero
C it experiences only one force
D all the external forces on the object are balanced

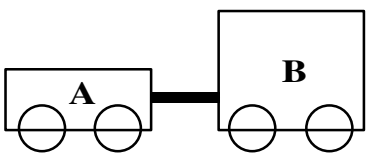
Which of the statements above is/are **true**?

1 A, B, C and D
2 A, B and D
3 A and B
4 A and C
5 A and D

Answer 2

The statement C is not true, but A, B and D are true

14 Two trolleys A and B move on a horizontal frictionless plane to the right. The mass of B is double that of A. The two trolleys are connected with a connected with a compressed spring. At a certain moment the spring is released very suddenly. The two trolleys now move in opposite directions.



The magnitude of the momentum of trolley A is now

1 the same as that of B and in the opposite direction
2 double that of B and in the same direction
3 bigger than that of B and in the opposite direction
4 smaller than that of B and in the opposite direction
5 bigger than that of B and in the same direction

Answer 4

Assume that the movement to the right is at a constant speed, u. Since there is no friction it is also possible to assume that when the spring has finished acting on A and B, that the speed of A is twice that of B, i.e. $V_A = 2V_B$ if they were at rest. But they are not, they are moving at speed u right. The question also says that after the spring has acted, the trolleys move in opposite directions.

This means that $|V_A| > |u|$, so then:

the speed of A = $V_A - u = 2V_B - u$ and the speed of B is $V_B + u$.

This means that the momentum, **P**, of A:

$|\mathbf{P}_A| = M(2V_B - u) = 2MV_B - Mu$, similarly

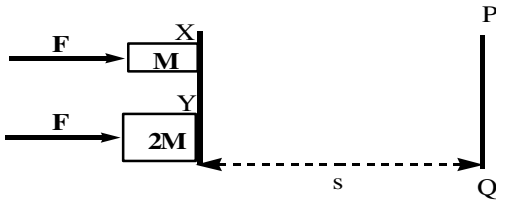
$|\mathbf{P}_B| = 2M(V_B + u) = 2MV_B + Mu$ and so $P_A < P_B$

Another way of looking at this is to simply argue that if the trolleys are at rest then their momentum afterwards is the same. Since there is a speed in one direction one object would have a speed slightly more than it should whilst the other slightly less than it

should, and so the former would have a greater momentum.

The following information must be used to answer the following three questions:

Two trolleys, X and Y, with mass M and 2M, are in equilibrium next to each other. Both are now pushed simultaneously in a straight line over a distance s by a constant force with magnitude F as shown in the diagram. Ignore all effects of friction (trolleys as seen from above).



15 Which trolley will reach line PQ first?

1 X
2 Y
3 Both at the same moment

Answer 1

Trolley X has a greater acceleration than trolley Y. So after traveling a distance s, trolley X would have a greater speed than trolley Y and so X reaches the line PQ first.

16 Which trolley will have the biggest momentum when reaching line PQ?

1 X
2 Y
3 Both the same

Answer 2

The acceleration of trolley X is:

$a_X = F/M$ and that of trolley Y,

$a_Y = F/2M$

Using $V^2 = U^2 + 2as$ we have for trolley X:

$v^2 = 2Fs/M$ since U = 0 and so

$v = \sqrt{(2Fs/M)}$ and for trolley Y

$V^2 = 2Fs/2M = Fs/M$ so $V = \sqrt{(Fs/M)}$

Momentum of X, P_X, is

$Mv = \sqrt{(2Fs/M)}M$ and that of Y,

P_Y, $2MV = \sqrt{(Fs/M)}2M$

Therefore $P_X/P_Y = 1/\sqrt{2}$ or $P_Y = \sqrt{2}P_X$

ie $P_Y > P_X$

17 Which trolley will have the biggest kinetic energy when reaching line PQ?

1 X
2 Y
3 Both the same

Answer 3

Using the calculations in 56 above, the kinetic energy of X and Y on reaching PQ is:

$E_X = ½ mv^2 = ½ \times M \times 2Fs/M = Fs$

$E_Y = ½ mV^2 = ½ \times 2M \times Fs/M = Fs$

ie $E_X = E_Y$

18 Two objects on isolated stands with charge +5 *nC* and -3 *nC* are placed a distance r apart. The force of attraction between the two objects is ***F***. They are now allowed to touch and are then put back in their original positions. The force of repulsion between the objects is now

1 $4\boldsymbol{F}$

2 $2\boldsymbol{F}/15$

3 $15\boldsymbol{F}$

4 $\boldsymbol{F}/15$

5 $\boldsymbol{F}/4$

Answer 4

Using Coulomb's Law of Electrostatics

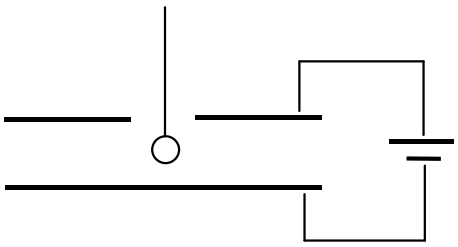
$F = kqQ/r^2$ for the original conditions:

$|F| = (k \times 3 \times 5)/r^2 = 15k/r^2$

Once the objects have touched each carries a charge of +1 nC, the force F' is:

$|F'| = (k \times 1 \times 1)/r^2 = k/r^2$ so $F' = F/15$

19 A lightweight round object is covered with a graphite layer and has been charged positively. It hangs from a string between two parallel charged plates as shown in the diagram. The mass of the object is ***m*** and the charge is ***q***. The electric field intensity between the two plates is ***E***.



The tension in the string is

1 $\boldsymbol{Eq} - \boldsymbol{m}g$

2 $\boldsymbol{m}gd/V$

3 $\boldsymbol{m}g - \boldsymbol{Eq}$

4 $\boldsymbol{m}g + \boldsymbol{Eq}$

5 $\boldsymbol{m}g$

Answer 4

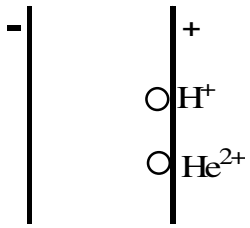
The upper plate is connected to the positive terminal of the cell.

This means that the upper plate carries a positive charge. The ball also carries a positive charge, so the weight and the electrostatic force on the ball both act downwards

Weight = mg and $F_E = qE$

$T = mg + qE$

20 A proton and an alpha particle are simultaneously released from the positive plate as indicated in the diagram. An alpha particle is a He^{2+} ion.



How will the kinetic energy of the two particles compare when they reach the negative plate?

1 It will be the same

2 The kinetic energy of the He^{2+} particle will be 2× more

3 The kinetic energy of the He^{2+} particle will be 4× more

4 The kinetic energy of the He^{2+} particle will be 2× less

5 The kinetic energy of the He^{2+} particle will be 4× less

Answer 2

The kinetic energy of an object is the same as the work done in gaining that kinetic

energy. From the definition of the volt - work done per unit charge, we get:

$V = W/q$ or that $W = Vq = E_K$

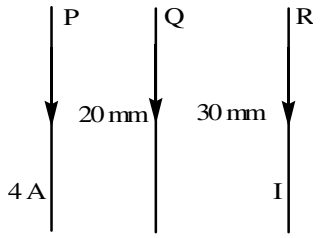
E_K (He) = V x 2e = 2Ve

E_K (H) = V x e = Ve

So the kinetic energy for the helium nucleus is twice that of the proton (hydrogen nucleus)

21 Three current-carrying conductors of the same length; P, Q and R are placed in parallel as shown in the diagram.

	SERIES	PARALLEL
1	2P	P
2	P	2P
3	4P	P
4	P	4P
5	P	P/2



What must the current strength in R be so that Q will stay in equilibrium between the other two fixed conductors in the positions shown?

1 2 A

2 4 A

3 5 A

4 6 A

5 8 A

Answer 4

The relation for the force between two parallel current carrying conductors is:

F = (kII'l)/d

So the force between P and Q is *F = k x 4 x I' x l/0.02 = 200kI'l*

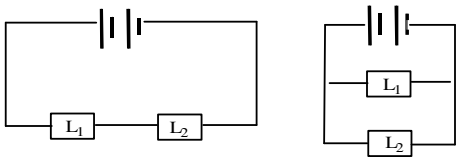
and the force between Q and R is

F = k x I x I' x l/0.03 = 33.33kII'l

If Q is to be in equilibrium, then the forces on Q must be equal, so:

200 = 33.33I or I = 200/33.33 = 6A

Two identical light bulbs L_1 and L_2 are first switched in series with a 12 V battery then in parallel with the same battery. **Use the information to answer the following two questions.**

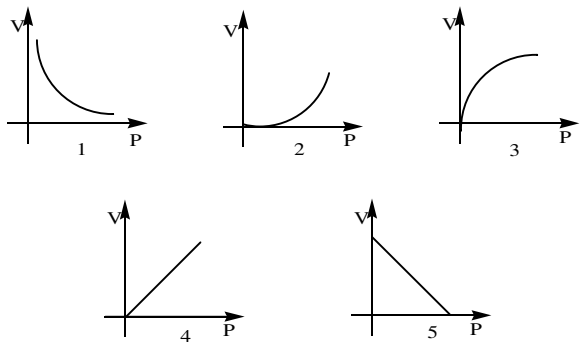


22 How will the power in L1 differ in the two cases?

Answer 4

Assuming that the current through L_1 (series) = i A, then the current through L_1 (parallel) = 2i A. Since the power in a conductor is proportional to i^2 the ratio of power will be 1:4, i.e. P and 4P

23 A graph is drawn of the potential difference V and the power P of L_1 in parallel. Which graph is the correct one?



Answer 2

Since the power is proportional to V^2, graph three correctly shows the relation between P and V.

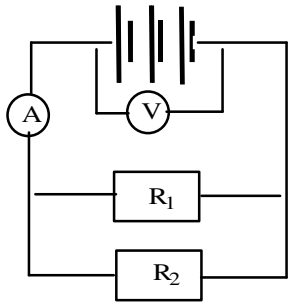
24 Four light bulbs, each 60 W, 220 V, are switched in parallel with a 220 V power source. What will happen to the current strength if one bulb is removed?

1 It will increase with 25%
2 It will decrease to 75% of the original current
3 There will be no current flowing
4 It will double
5 There is too little information given to say

Answer 2

Assume the current is i A through each bulb. This means total current is 4i A. With one bulb less current will be 3i A: 75% of the previous current.

25 In the following circuit the battery has an internal resistance. The resistance of the ammeter is very low and that of the voltmeter is very high.



What will happen to the ammeter and voltmeter readings in this circuit when another resistor is switched in parallel with R_1 and R_2?

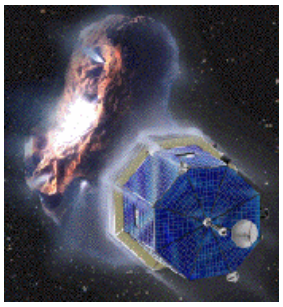
	Ammeter Reading	**Voltmeter Reading**
1	Increases	Decreases
2	Decreases	Increases
3	Decreases	Stays the same
4	Increases	Stays the same
5	Decreases	Decreases

Answer 1

With an extra resistor in parallel, the total current in the circuit will increase. Since the battery has internal resistance the PD across it will decrease.

Photos and Sketches

Refer to page 1



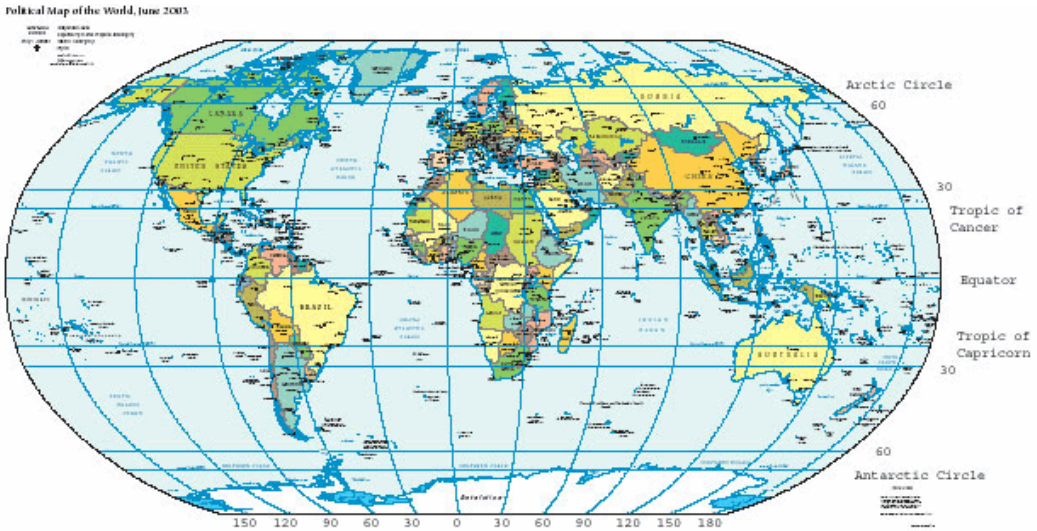
CONTOUR

Comet Encke

Comet Schwassmann-Wachmann

Refer to page 4

Refer to page 8



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