SAASTA
SOUTH AFRICAN AGENCY FOR SCIENCE AND TECHNOLOGY ADVANCEMENT

NATIONAL SCIENCE Olympiad

Past Examination Questions and Answers: Physics Section

[2005 - 2006]

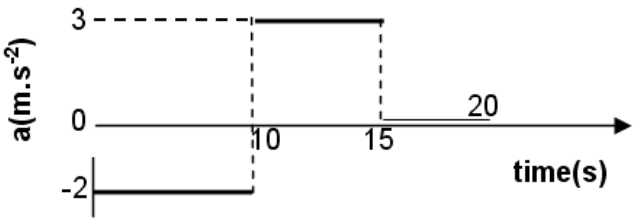
A flagship project of the South African Agency for Science and Technology Advancement, a business unit of the National Research Foundation (NRF)

PAST EXAMINATION QUESTION AND ANSWERS 2005

Consult the data sheet provided on the last page of the question paper when necessary to assist in answering questions in this section.

Use the following information to answer questions 41 and 42:

A car is moving on a straight, horizontal road at 30 $m.s^{-1}$ in an easterly direction. The acceleration of the car for the following 20 s is shown in the graph below as a function of time.



1. The velocity of the car at 20 s is……

   1. 5 $m.s^{-1}$ east
   2. 25 $m.s^{-1}$ east
   3. 5 $m.s^{-1}$ west
   4. 25 $m.s^{-1}$ west

Answer 2

For 10 s the car has acceleration = - 2 $m.s^{-2}$, ie it loses 20 m. s^{-1} of speed. Then for 5 s it has an acceleration of 3 m. s^{-2}, ie it gains 15 m. s^{-1} of speed. Since it started with 30 m. s^{-1}, the final speed will be 25 m. s^{-1} East.

Or Δv (change of speed) = area under the a-t graph = (- 2 x 10) + (3 x 15) = (- 20 + 15) = - 5 m. s^{-1} so the final speed will be 30 – 5 = 25 m. s^{-1} East as before.

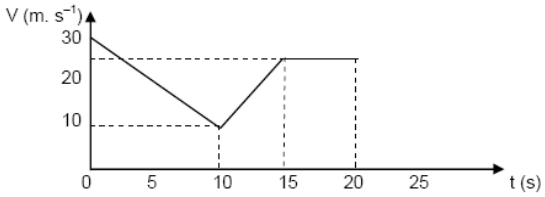
Comment: The phrase ". . . in an easterly direction . . ." is not precise. Better would be to say ". . . car is travelling at 30m. s^{-1} East . . . "

2. During the 20s the car is stationary……

   1. from 0 to 10 seconds
   2. from 10 to 15 seconds
   3. from 15 to 20 seconds
   4. never

Answer 4

Since the velocity of the car is always > 0 it will not be stationary at any time during the 20 s period. This can also be shown by drawing the v-t graph:



3. A stone is dropped from rest and freely falls a distance x in 1 s. How much further will it fall in 3 s?

   1. 2x
   2. 3x
   3. 8x
   4. 9x

Answer 3

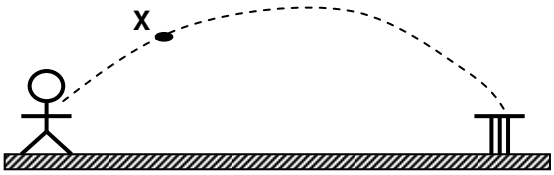
Using the equation $s = ut + ½ at^2$ ie $s \propto t^2$ so when t = 1 s distance $s \propto x$. So when t = 3, $s \propto 9x$, ie object travels a further 8x m

Or for t = s and u = 0 we have:

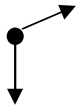
$s_1 = 0 + ½ \times 10 \times 12 = 5$ m = x. Similarly, for t = 3 and u = 0 we have:

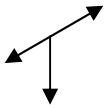
$s_3 = 0 + ½ \times 10 \times 32 = 45$ m = 9x, ie object travels 8x metres further, as before.

4. A boy throws a cricket ball from the boundary to the wickets. If frictional forces cannot be ignored, which of the following represents the forces acting on the ball at position X?



1.


2.


3.


4.


Answer 1

The only forces acting on the ball are the air-resistance, backwards from the direction of motion and the ball's weight, acting downwards.

5. A boy has two spare light bulbs in his drawer. One is marked 240 V and 100 W, the other is marked 240 V and 60 W. He tries to decide which will burn more brightly and why. Which of the following assertions is correct?

1. The 60 W light bulb has more resistance and therefore burns less brightly
2. The 60 W light bulb has less resistance and therefore burns less brightly
3. The 100 W light bulb has more resistance and therefore burns more brightly
4. The 100 W light bulb has less resistance and therefore burns less brightly

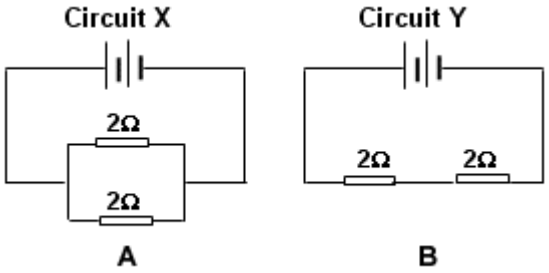
Answer 1

It is clear that the 100 W bulb will be brighter than the 60 W bulb. Also:

Power = V x I = V^2/R. But V is the same in both cases, so power $\propto$ 1/R, ie higher power means lower resistance. Looking at all the statements given in the answers:

1 is true, 2 is false, 3 is false and 4 is false. See the general comments.

6. Two 2Ω resistors are connected in parallel in circuit X and in series in circuit Y. The batteries in the two circuits are identical and have zero internal resistance. Assume that the energy transferred to resistor A in circuit X within a certain time is W. The energy transferred to resistor B in circuit Y in the same time, will be……..



1. ¼ W
2. ½ W
3. 2W
4. 4W

Answer 2

In circuit X the PD across A, a 2 Ω resistor, is V volts. Also Power W = $V^2/R = V^2/4$

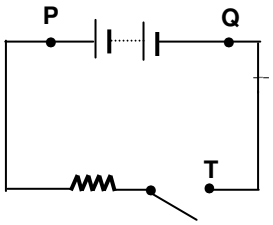
In circuit Y the PD across B*, a 2 Ω resistor, is V/2 volts, W = $V^2/R = V^2/8$ = W/2

* It is not clear which resistor is B, but since both are the same it doesn't matter.

7. A battery, an open switch and a resistor are connected in series as shown below. Consider the following three statements concerning the circuit.

   A voltmeter will read zero if it is connected across points ……

   (i) P and T
   (ii) P and Q
   (iii) Q and T



   Which one of the above is/are true?

   1. Only (i)
   2. Only (iii)
   3. Only (i) and (iii)
   4. (i), (ii) and (iii)

Answer 2

In this circuit, Q and T are effectively the same point, so there is no PD between them. So only the PD across QT = 0, i.e. statement (iii) is true.

In fact it doesn't matter whether or not the switch is open or closed!

8. A black car and a white car follow one another on a long journey. They arrive at their destination when it is dark and park next to one another. Which car bonnet will be hotter 30 minutes after parking?

   1. The black car since black is the best absorber of heat
   2. The white car since white is the best absorber of heat
   3. The black car since black is the worst emitter of heat
   4. The white car since white is the worst emitter of heat

Answer 4

Black is a better absorber and emitter of energy (heat), and assuming that the cars are physically identical and that the bonnets start off at the same temperature, it is possible to analyse the four answers:

1 and 4 are true, whilst 2 and 3 are false. But if the above assumptions are true then the answer is 4 since it will lose less heat and so will be at a higher temperature. Bad question: see general comments.

9. Which type of wave is used in TV remote control devices?

   1. Infra-red waves
   2. Radio waves
   3. Microwaves
   4. Ultra-violet waves

Answer 1

Most control remotes for electronic appliances use a near infrared diode to emit a beam of light that reaches the device. This light is invisible to the human eye but carries signals that are detected by the appliance, as well as by the sensor of a digital camera (you can easily demonstrate this by pointing a camera-phone at the remote and pressing some buttons, this is particularly useful for checking functioning of the unit)

10. In a period of 1 minute, 20 wave crests move past a pole planted in water. The frequency and the period of the wave crests are……

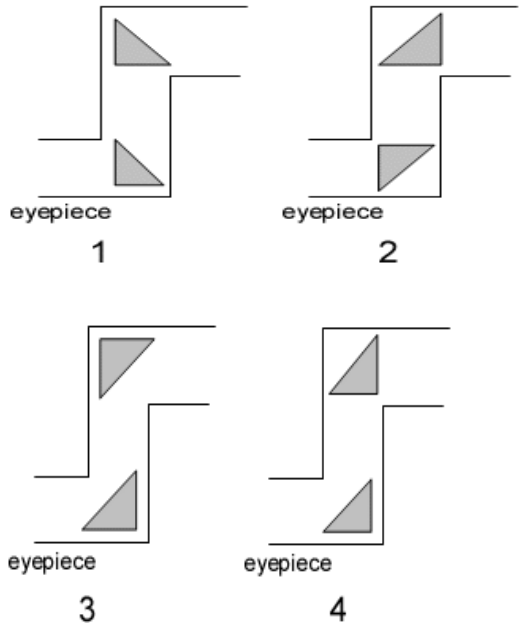
	Frequency (Hz)	Period (s)
1	20	60
2	0,05	20
3	0,333	3
4	3	0,3333

Answer 3

Frequency can be thought of as number of "crests" per second, i.e. 20/60 = 0.33 Hz. Then since the frequency f = 1/T, where T is the period, or the time it takes one crest to pass the pole, the period is

T = 1/f = 3 s.

11. Prisms are used in a periscope, an extremely important device in a submarine. Which of the following diagrams shows the correct use of prisms in the periscope?

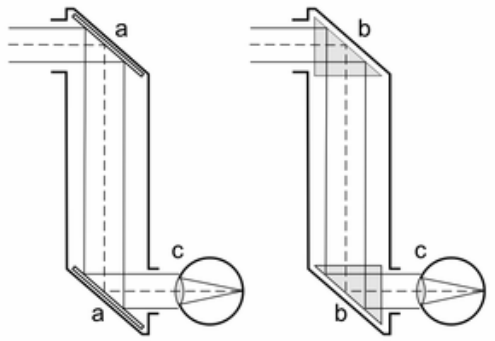


Answer 2

A ***periscope*** is an instrument for observation from a concealed position. In its simplest form it is a tube in each end of which are mirrors set parallel to each other and at an angle of 45° with a line between them.

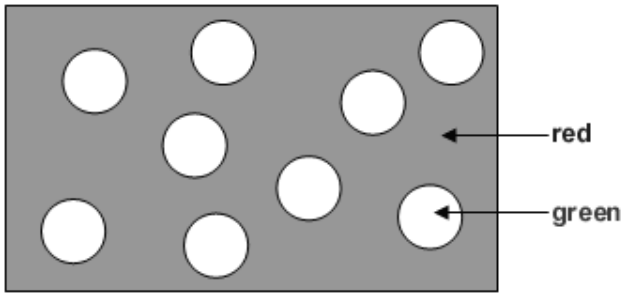
More complex periscopes, using prisms instead of mirrors, and providing magnification, are used on submarines. The overall design of the classical submarine periscope is very simple: two telescopes pointed into each other. If the two telescopes have different individual magnification, the difference between them causes an overall magnification or reduction.

The correct diagram is no 2:



Principle of the periscope: The periscope on the left uses mirrors at location "a" whereas the right uses prisms at "b". The observer is "c".

12. When a **red** paper with **green** dots on it is seen in white light it looks like this:



What will you see if this same paper is illuminated by a red light in a dark room?

1. Dark red spots on a green paper
2. Black spots on a red paper
3. No spots, everything is just black
4. Red spots on a black paper

Answer 2

The paper appears red because it only reflects red light. The dots appear to be green because they only reflect green light. If the paper is illuminated with monochromatic red light, then the paper will reflect red light and the green dots no light, i.e. appear black.

13. The speed of sound in air is about 330 $m.s^{-1}$. Pat sees a flash of lightning then hears the clap of thunder 4 seconds later. How far from her was the flash of lightning?

1. 1320 m
2. 660 m
3. 82, 5 m
4. 0,012 km

Answer 1

The speed of light >> than the speed of sound. This means that Pat sees the flash almost instantaneously. Speed = dist/time, i.e. distance = speed x time

So d = 330 x 4 = 1320 m.

Lightning is an atmospheric discharge of electricity, which typically occurs during thunderstorms, and sometimes during volcanic eruptions or dust storms.[1] A bolt of lightning can travel at a speed of 100000 mph (160934 km/h), and can reach temperatures approaching 28000 °C (60000 °F), hot enough to fuse soil or sand into glass channels. There are over 16 million lightning storms every year. Lightning can also occur within the ash clouds from volcanic eruptions, or can be caused by violent forest fires which generate sufficient dust to create a static charge. How lightning initially forms is still a matter of debate: Scientists have studied root causes ranging from atmospheric perturbations (wind, humidity, and atmospheric pressure), to the impact of solar wind and accumulation of charged solar particles. Ice inside a cloud is thought to be a key element in lightning development, and may cause a forcible separation of positive and negative charges within the cloud, thus assisting in the formation of lightning.

14. John tries to make an electromagnet that he has built himself, stronger. He does the following:

    (i) Winds more turns around the soft-iron core.
    (ii) Uses more cells in the battery
    (iii) Uses more hard-iron in the core
    (iv) Winds the copper wire turns closer to one another without adding any additional turns

    Which of the plans that he made will strengthen the electromagnet?

    1. Only (i) and (iii)
    2. Only (i) and (ii)
    3. (i), (ii) and (iv)
    4. (i), (ii), (iii) and (iv)

Answer

An electromagnet is a type of magnet in which the magnetic field is produced by the flow of an electric current. The magnetic field disappears when the current ceases. British electrician William Sturgeon invented the electromagnet in 1825. The simplest type of electromagnet is a coiled piece of wire. A coil forming the shape of a straight tube (similar to a corkscrew) is called a solenoid; a solenoid that is bent so that the ends meet is a toroid. Much stronger magnetic fields can be produced if a "core" of paramagnetic or ferromagnetic material (commonly soft iron) is placed inside the coil. The core concentrates the magnetic field that can then be much stronger than that of the coil itself. In order to build a strong electromagnet, a short magnetic circuit with large area is preferred. Most ferromagnetic materials saturate around 1 to 2 teslas.

Statements i and ii are true, whilst statements iii and iv are false. However it should state that the copper wire has a very low resistance and that the amount of wire wound onto the soft iron core is such that its resistance is small enough not to counter the addition of extra cells: the current needs to increase. Not a well set question.

15. To make a toy motor car work off a 12 V power source a transformer needs to be used since the toy car is actually designed to work off a 240 V power source. If the primary of the transformer has 360 turns, what must the number of turns in the secondary be?

    1. 7200
    2. 180
    3. 18
    4. 8

Answer 3 m (Answer 1 could also be accepted because of the ambiguity)

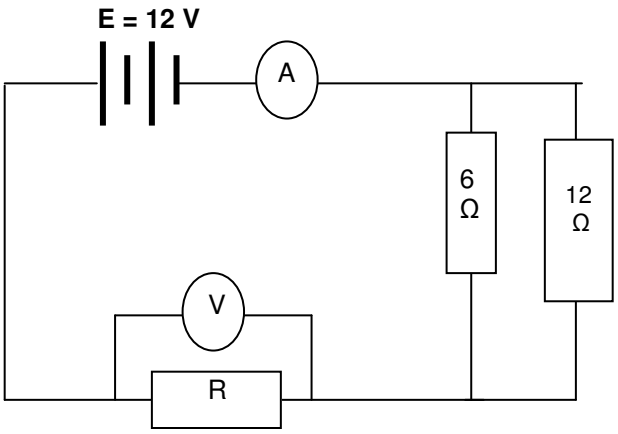
Assuming* the toy car uses 12V to run its motor and the supply is 240V**. This means that it will need a step down transformer:
$V_P/N_P = V_S/N_S$ or that $N_S = V_S \times N_P/V_P = 12 \times 360/240 = 18$ turns.

* It is not clear from the question what is what!

** However the question should probably have read that the power supply was 240

V and that the toy car's motor used 12 V – as it stands the question is ambiguous, or at best difficult to understand.

16. A circuit is arranged as shown in the diagram. The battery has no internal resistance.



If the reading on the voltmeter is 4 **V**, what will the reading on the ammeter be?

1. 1A
2. 2A
3. 3A
4. 4A

Answer 2

PD across the 6 Ω and 12 Ω resistors is 8 V (12 – 4 = 8). Since Ohm's Law is V = I x R we have that

I = V/R, so I_6 = 8/6 = 4/3 A and I_{12} = 8/12 = 2/3 A The reading in the ammeter:

$I = I_6 + I_{12}$ = 4/3 + 2/3 = 6/3 = 2 A

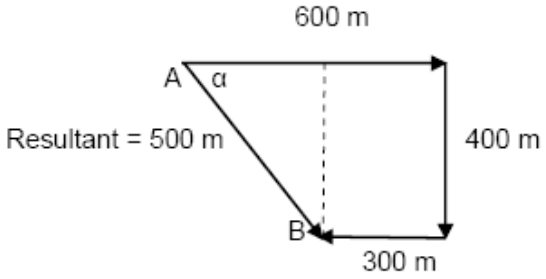
Questions 57 and 58 are based on the following information:

Peter first runs 600 m east, then 400 m south, and finally 300 m west in a total time of 10 min.

17. The magnitude of his average velocity and average speed in $m.s^{-1}$ will be……

	Average velocity	Average speed
1	2,17	0,83
2	0,83	2,17
3	130	50
4	50	130

Answer 2



Using the 3:4:5 triangle rule the resultant

A α

Displacement, AB, is 500 m.

Resultant = 500 m 400 m

Total distance is 1 300 m

Total displacemnt is 500 m

Time taken to get from A to B is 10 minutes = 600 300 m

Remember the final dispacement is from where you started, A,

To where you finished, B.

Average speed is 1300/600 = 2.17 $m.s^{-1}$

Average velocity is 500/600 = 0.83 $m.s^{-1}$

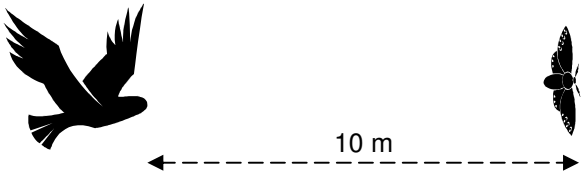
18. The direction of his final displacement is…….

    1. 53,13º S of E.
    2. in the direction 53,13º.
    3. 36,87º W of N.
    4. in the direction 323,13º.

Answer 1

The angle α is needed. Tan α = 400/300, so α = 53.13^{o} and it is south of east.

19. An insect and a bird fly one behind the other as shown in the sketch. The insect flies at a speed of 1 m.s^{-1} and the bird at 11 m.s^{-1}. At a given moment they are exactly 10 m from one another.



How long will it take the bird, from this given moment, to catch up with the insect?

    1. 1,1 s.
    2. 10 s.
    3. 1 s.
    4. Impossible to calculate.

Answer 3

The relative velocity, V_R, = bird's velocity V_B less the insects velocity V_I

So $V_R = V_B - V_I = (11 - 1) = 10$ m.s^{-1}

Speed = dist/time so time = dist./speed = 10/10 = 1 s

20. Tom is running on a train wagon which is moving at 20 m.s^{-1} in an easterly direction. He is running in the direction directly opposite to that in which the train is moving, and at a velocity of 5 m.s^{-1} relative to the wagon.

    At what velocity is he moving relative to the ground?

    1. 25 m.s^{-1} east.
    2. 25 m.s^{-1} west.
    3. 15 m.s^{-1} east.
    4. 15 m.s^{-1} west.

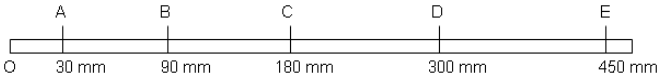
Answer 3

Tom's relative velocity to the ground is simply the train wagon's velocity less his velocity,

ie. (20 – 50) = 15 m.s^{-1}. It is also clear that Tom is moving eastwards more quickly than he is running, so his relative velocity is east.

The next two questions, questions 61 and 62, are based on the following information:

The frequency of a time-ticker apparatus is 20 Hz. The ticker ribbon is attached to a trolley which has pulled the ribbon through the ticker apparatus. The markings on the ribbon are made at 10-tick intervals. The ribbon is shown below, and all the distances are measured from the starting point 0.



21. What is the increase in the trolley's velocity from one ticker mark to the next?

1. 0,06 $m.s^{-1}$
2. 0,03 $m.s^{-1}$
3. 0,6 $m.s^{-1}$
4. 0,3$m.s^{-1}$

Answer 1

If the frequency is 20 Hz, then the period is $1/20^{th}$ s and the time for 10 ticks is ½ s.
The the average speed between A and B is:

v_{AB} = 60/½ = 120 $mm.s^{-1}$ similarly, v_{BC} = 90/½ = 180 $mm.s^{-1}$, v_{CD} = 120/½ = 240 $mm.s^{-1}$ etc.

This means that change in velcity per tick is 60 $mm.s^{-1}$ = 0.06 $m.s^{-1}$

22. What is the acceleration of the trolley that pulled the ticker ribbon through the time ticker?

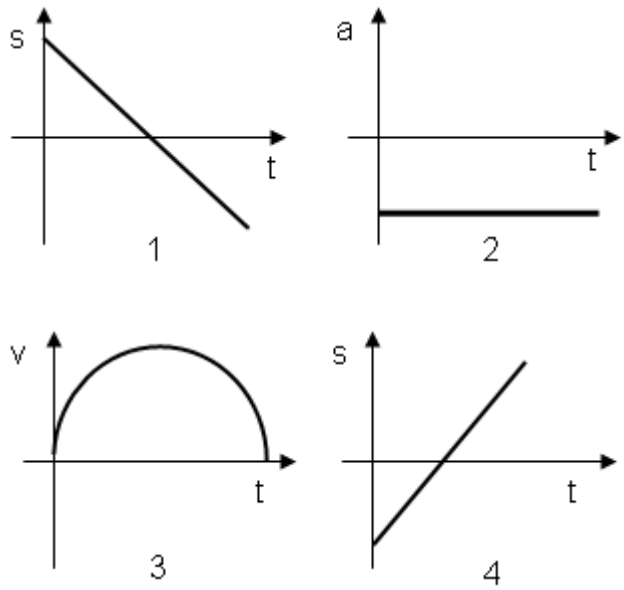
1. 0,06 $m.s^{-2}$
2. 0,6 $m.s^{-2}$
3. 1,2 $m.s^{-2}$
4. 0,12 $m.s^{-2}$

Answer 4

Acceleration = (change in velocity)/(change in time). The average velocity occurs at mid-interval (halfway between ticks) so to get from V_{AB} to V_{BC} takes ½ s, so the acceleration a, is

a = (180 – 120) = 60 $mm.s^{-1}$/½ s = 120 $mm.s^{-2}$ = 0.12 $m.s^{-2}$

23. Which of the following graphs is the correct one to describe the movement of a ball which is thrown vertically up into the air and then falls straight back to earth?



Answer 2

Graphs 1 and 4 are false since $s \propto t^2$, so the graphs cannot be straight lines. Graph 3 is false since the velocity in increasing and then decreasing. The acceleartion due to gravity is constant and < 0.

24. In the equation of motion $s = ut + ½at^2$, the unity of the term "$½at^2$" is ……

1. m
2. $m.s^{-1}$
3. $m.s^{-2}$
4. $m^2.s^{-2}$

Answer 1

There is no such phrase as ". . . the unity of the term. . .", it should be " . . .the units of . ."

Since s has the unit of metres, m, then so must ut and ½ at^2 for the equation to be consistent.

This is actually something called "Dimensional Anysis": making sure that the units of an equation are consistent. Displacement s has the dimensions of length [L]. Velocity has the dimensions length divided by time, ie $[L][T]^{-1}$. Similarly, acceleration has dimensions $[L][T]^{-2}$.

So ½ at^2 would have dimensions$[L][T]^{-2}$ $[T]^2$ = [L]. The units for length are metres, m.

25. A cricket ball is thrown vertically upwards with an initial speed of 20 $m.s^{-1}$. What are the height, speed and acceleration of the ball after 1 second? Ignore all effects of air resistance.

	Height	Speed	Acceleration
1	15 m	10 $m.s^{-1}$	10 $m.s^{-2}$ op
2	5 m	5 $m.s^{-1}$	10 $m.s^{-2}$ op
3	15 m	10 $m.s^{-1}$	10 $m.s^{-2}$ af
4	5 m	10 $m.s^{-1}$	10 $m.s^{-2}$ af

Answer 3

Translation error from Afrikaans to English **op** and **af** should be **up** and **down**.

The acceleration is 10 $m.s^{-2}$ down. So answers 1 and 2 cannot be right. Using s = ut + ½ at^2

we have s = 20 + ½ (– 10) = 20 – 5 = 15 $m.s^{-1}$. Then using v = u + at we get:

v = 20 – 10 = 10 $m.s^{-1}$.

PAST EXAMINATION QUESTION AND ANSWERS 2006

SECTION A: GENERAL SCIENCE KNOWLEDGE

1. The “Genome” project was:

   A. The beginnings of stem cell research
   B. The ‘unravelling’ and classification of human DNA
   C. The launching of a satellite to land on a comet
   D. The drilling of a deep hole into the Earth’s crust.

Answer B (Wikipedia)

The Human Genome Project (HGP) is a project undertaken with a goal to understand the genetic make-up of the human species by determining the DNA sequence of the human genome and the genome of a few model organisms. The project began in 1990, and by some definitions, it was completed in 2003. It was one of the biggest investigation projects in the history of science. The mapping of the human genes was an important step in the development of medicines and other aspects of health care. Most of the genome DNA sequencing for the Human Genome Project was done by researchers at universities and research centers in the United States and Great Britain, with other genome DNA sequencing done independently by the private company Celera Genomics. The HGP was originally aimed at the more than three billion nucleotides contained in a haploid reference human genome. Recently several groups have announced efforts to extend this to diploid human genomes including the International HapMap Project, Applied Biosystems, Perlegen, Illumina, JCVI, Personal Genome Project, and Roche-454. The "genome" of any given individual (except for identical twins and cloned animals) is unique; mapping "the human genome" involves sequencing multiple variations of each gene. The project did not study all of the DNA found in human cells; some heterochromatic areas (about 8% of the total) remain un-sequenced.

2. When was the last **total** solar eclipse (eclipse of the Sun) visible in South Africa?

   A. June 21, 2001
   B. December 04, 2002
   C. January 09, 2001
   D. May 04, 2004

Answer B (Wikipedia)

December 4, 2002 05:50 07:31 9:11 total 02:04 min (South Africa, Antarctica, Indonesia, Australia) Solar eclipse of 2002 December 4.

A solar eclipse occurs when the Moon passes between Earth and the Sun, thereby totally or partially obscuring Earth's view of the Sun. This configuration can only occur during a new moon, when the Sun and

Moon are in conjunction as seen from the Earth. In ancient times, and in some cultures today, solar eclipses are attributed to mythical properties. Total solar eclipses can be frightening events for people unaware of their astronomical nature, as the Sun suddenly disappears in the middle of the day and the sky darkens in a matter of minutes. However, the spiritual attribution of solar eclipses is now largely disregarded.

Total solar eclipses are very rare events for any given place on Earth because totality is only seen where the Moon's umbra touches the Earth's surface. A total solar eclipse is a spectacular natural phenomenon and many people consider travel to remote locations in order to observe one. The 1999 total eclipse in Europe, said by some to be the most-watched eclipse in human history, helped to increase public awareness of the phenomenon. This was illustrated by the number of people willing to make the trip to witness the 2005 annular eclipse and the 2006 total eclipse. The next solar eclipse takes place on 7 February 2008, while the next total solar eclipse will occur on August 1, 2008.

3. In November 2005 President Thabo Mbeki opened a major new scientific instrument in Southern Africa What is it and where can it be seen?

   A. The HESS high energy telescope outside the Gamsberg, in Namibia
   B. The first Pebble Bed Modular Reactor, PBMR, near Koeberg
   C. The Southern African Large Telescope, SALT, outside Sutherland in the Karoo
   D. The Karoo Array Telescope, KAT, in the Northern Cape.

Answer C (Independent OnLine)

November 10, 2005.

The Southern African Large Telescope (SALT) will enable the country to remain among the front ranks of those involved in astronomy, President Thabo Mbeki said on Thursday. Speaking at the inauguration of the SALT at the South African Astronomical Observatory near Sutherland in the Northern Cape, he said the global scientific community would benefit greatly from the venture. "Even those of us who know nothing about astronomy have awaited this day with great anticipation... that this giant eye in the Karoo will tell us as yet unknown and exciting things about ourselves," he said. Among the fundamental questions about the universe SALT would tackle were what it was like when the first stars and galaxies were formed, what kind of worlds orbit other suns, and how stars in nearby galaxies differ from those in the solar system. The inauguration of SALT was attended by about 1000 guests, including Science and Technology Minister Mosibudi Mangena, his deputy Derek Hanekom, and Northern Cape Premier Dipuo Peters. - Sapa

4. When using the WWW, what do the letters **http** stand for?

A. Highspeed Transfer TyPe
B. A degeneration of the slang term "HoT Transfer Process"
C. Hyper-Text Transport Protocol
D. HewleTT Packard data transfer

Answer C (Wikipedia)

Hypertext Transfer Protocol (HTTP) is a communications protocol used to transfer or convey information on the World Wide Web. Its original purpose was to provide a way to publish and retrieve HTML hypertext pages. Development of HTTP was coordinated by the W3C (World Wide Web Consortium) and the IETF (Internet Engineering Task Force), culminating in the publication of a series of RFCs, most notably RFC 2616 (1999), which defines HTTP/1.1, the version of HTTP in common use today. HTTP is a request/response protocol between clients and servers. The client making an HTTP request - such as a web browser, spider, or other end-user tool - is referred to as the *user agent*. The responding server - which stores or creates resources such as HTML files and images - is called the *origin server*. In between the user agent and origin server may be several intermediaries, such as proxies, gateways, and tunnels. It is useful to remember that HTTP does not need to use TCP/IP or its supporting layers. Indeed HTTP can be "implemented on top of any other protocol on the Internet, or on other networks. HTTP only presumes a reliable transport; any protocol that provides such guarantees can be used."

5. Which one of the following is the shortest length?

A. picometre
B. millimetre
C. micrometre
D. nanometre

Answer A

By definition, pico means one trillionth (10^{-12}), milli means one thousandth part of, micro means one millionth and nano means one billionth (10^{-9}). Thus Option A is correct.

6. When you see a full Moon rise, you would expect the Sun to be:

A. Overhead
B. Rising
C. Setting
D. You cannot see the Moon when the Sun is up.

Answer C

Full moon is a lunar phase that occurs when the Moon is on the opposite side of the Earth from the Sun, and when the three celestial bodies are aligned as close as possible to a straight line. At this time, as seen by viewers on Earth, the hemisphere of the Moon that is facing the Earth (the near side) is fully illuminated by the Sun and appears round. Only during a full moon is the opposite hemisphere of the Moon, which is not visible from Earth (the far side), completely unilluminated. Thus, option C is correct.

7. **Bauxite** is the ore of which mineral?

A. Boron
B. Beryllium
C. Aluminium
D. Lithium

Answer C (Wikipedia)

Bauxite is an aluminium ore. It consists largely of the minerals gibbsite $Al(OH)_3$, boehmite and diaspore AlOOH, together with the iron oxides goethite and hematite, the clay mineral kaolinite and small amounts of anatase TiO_2. It was named after the village Les Baux-de-Provence in southern France, where it was first discovered in 1821 by geologist Pierre Berthier.

8. Which are the four most common elements in the Earth's crust?

   A. Aluminium, Oxygen, Iron, Silicon
   B. Oxygen, Hydrogen, Iron, Silicon
   C. Hydrogen, Oxygen, Iron, Aluminium
   D. Sodium, Hydrogen, Oxygen, Iron

Answer A (Encyclopaedia Britannica)

The crust is a comparatively thin shell on the surface of the Earth and makes up less than 1 percent of its
total mass. Its geochemical significance is only marginally related to its bulk, however. It has been subjected to extensive investigations, and it provides the raw materials on which civilization depends. It is the most diverse of the geospheres, being a complex mosaic of many rock types—igneous, sedimentary, and metamorphic—each with a wide variety of chemical and mineralogical compositions. The surface is veneered with soils, related in composition to the rocks from which they formed, but with important modifications because of the smaller grain size, the presence of organic matter, and an intricate complex of living organisms. Ultimately, man's welfare and indeed his survival depends on the wise utilization of the materials in the crust. Modern civilization has been erected upon the exploitation of fuels and ore deposits, which are simply geochemical concentrations of useful elements.

Perhaps the most significant feature of the composition of the Earth's crust is that it is dominated by comparatively few elements. Only eight—oxygen, silicon, aluminium, iron, calcium, magnesium, sodium, and potassium—are present in amounts greater than 1 percent, and these eight make up almost 99 percent of the whole. Of these, oxygen comprises almost 50 percent by weight. The dominance of oxygen is even more marked when weight percentages are converted to atomic percentages, as follows: oxygen (weight percentage, 46.6; atomic percentage, 62.2), silicon (27.7; 21.2), aluminium (8.13; 6.47), iron (5.00; 1.92), calcium (3.63; 1.94), magnesium (2.09; 1.84), sodium (2.83; 2.64), potassium (2.59; 1.42). This comparison, of course, merely emphasizes the fact that the crust consists almost entirely of oxygen compounds, mostly silicates and aluminosilicates of iron, calcium, magnesium, and the alkali metals.

9. Which animal on Earth has the largest eye?

   A. Blue whale
   B. Elephant
   C. Giant squid
   D. Hippopotamus

Answer C (Wikipedia)

Here are some statistics that are note-worthy.

- The Atlantic Giant Squid has the largest recorded eyes of any animal with an approximate diameter of 50 centimetres (20 inches) although those of the Colossal Squid are thought to reach an even greater size.
- The giraffe has the longest neck as well as the longest tail of any land mammal.
- The Wandering Albatross has the largest wingspan at 3.63 metres (11 feet 11 inches).
- The longest horns ever recorded belonged to a wild Water Buffalo and measured 4.24 metres (13 feet 11 inches) from tip to tip. The Greater Kudu has the longest horns on average.
- The largest and heaviest brain belongs to the Sperm Whale, weighing around 9 kilograms.
- The largest heart belongs to the Blue Whale and can weigh over 900 kilograms.
- The Arctic Lion's mane jellyfish is the longest animal; the biggest had a bell (body), with a diameter of 7 feet 6 inches and the tentacles reached 120 feet. It was found washed up on the shore of Massachusetts Bay in 1870. Bootlace worms can reach great lengths. A specimen was measured at 55m (180 feet) but this may be unreliable as the body is somewhat elastic.

10. Tuberculosis (TB) is a disease of the:

    A. kidneys
    B. heart
    C. lungs
    D. liver

Answer A (Encyclopaedia Britannica)

Tuberculosis is an infectious disease that is caused by the tubercle bacillus, *Mycobacterium tuberculosis*. In most forms of the disease, the bacillus spreads slowly and widely in the lungs, causing the formation of hard nodules (tubercles) or large, cheese-like masses that break down the respiratory tissues and form cavities in the lungs. Blood vessels also can be eroded by the advancing disease, causing the infected person to cough up bright red blood. During the 18th and 19th centuries, tuberculosis reached near-epidemic proportions in the rapidly urbanizing and industrializing societies of Europe and North America. Indeed, “consumption,” as it was then known, was the leading cause of death for all age groups in the Western world from that period until the early 20th century, at which time improved health and hygiene brought about a steady decline in its mortality rates. Since the 1940s, antibiotic drugs have reduced the span of treatment to months instead of years, and drug therapy has done away with the old TB sanitariums where patients at one time were nursed for years while the defensive properties of their bodies dealt with the disease. Still, in less-developed countries where population is dense and hygienic standards are poor, tuberculosis remains a major fatal disease. In addition, the prevalence of the disease has increased in association with the HIV

epidemic; tuberculosis is one of the main causes of death among AIDS patients. Finally, some new strains of the tubercle bacillus that are resistant to conventional antibiotics have appeared, requiring the use of combinations of drugs.

11. What would you associate with **viticulture**?

A. The growing of fungus on stale bread
B. The growing of mushrooms
C. The growing of tropical fruit
D. The cultivation of grapevines

Answer A (Wikipedia)

Viticulture (from the Latin word for *vine*) is the science, production and study of grapes which deals with the series of events that occur in the vineyard. When the grapes are used for winemaking, it is also known as viniculture. It is one branch of the science of horticulture. Duties of the Viticulturalist include: monitoring and controlling pests and diseases, fertilizing, irrigation, canopy management, monitoring fruit development and characteristics, deciding when to harvest and vine pruning during the winter months. Viticulturalists are often intimately involved with winemakers, because vineyard management and the resulting grape characteristics, provide the basis from which winemaking can begin.

12. Ascorbic Acid is another name for:

A. Aspirin
B. Vitamin C
C. Vitamin A
D. Vinegar

Answer B (Encyclopaedia Britannica)

Vitamin C, also called ascorbic acid is a water-soluble, carbohydrate-like substance that is involved in certain metabolic processes of animals. Although most animals can synthesize vitamin C, it is necessary in the diet of some, including humans and other primates, in order to prevent scurvy, a disease characterized by soreness and stiffness of the joints and lower extremities, rigidity, swollen and bloody gums, and hemorrhages in the tissues of the body. First isolated in 1928, vitamin C was identified as the curative agent for scurvy in 1932.

Vitamin C is essential for the synthesis of collagen, a protein important in the formation of connective tissue and in wound healing. It acts as an antioxidant, protecting against damage by reactive molecules called free radicals. The vitamin also helps in stimulating the immune system. It has been shown in animal trials that vitamin C has some anti-carcinogenic activity.

13 The movement of air near a low pressure system in the southern hemisphere is:

A. clockwise
B. anticlockwise
C. away from the centre
D. towards the centre

Answer A (Wikipedia)

A low pressure area, or a low for short, is a region where the atmospheric pressure is lowest with relation to the surrounding area. Tropical storms, extra-tropical cyclones, sub-polar cyclones, and sub-arctic cyclones

are called low-pressure cells in some English-speaking communities. Lows are frequently associated with stronger winds and atmospheric lift. This lift will generally produce cloud cover, due to adiabatic cooling, once the air becomes saturated as it rises. Thus, low pressure typically brings cloudy or overcast skies, which may minimize diurnal temperature extremes in both summer and winter, due to the significant cloud cover. This is due to less incoming shortwave solar radiation and lower temperatures during the day, since the clouds reflect sunlight. At night, the absorptive effect of clouds on outgoing long-wave radiation, such as heat energy from the surface, allows for warmer diurnal low temperatures in all seasons.

A large low-pressure system swirls off the southwestern coast of Iceland, illustrating the maxim that "nature abhors a vacuum." The vacuum in this case is a region of low atmospheric pressure. In order to fill this void, air from a nearby high-pressure system moves in, pulling in clouds along for the ride. And because this low-pressure system occurred in the Northern Hemisphere, the winds spun in toward the center of the low-pressure system in a counter-clockwise direction; a phenomenon known as the Coriolis effect (in the Southern Hemisphere, the Coriolis effect would be manifested in a clockwise direction of movement).

14. The basic colours used by a colour television to create the picture are:

    A. the seven colours of the rainbow
    B. red, green and blue
    C. red, blue, green and yellow
    D. red, yellow and blue.

Answer B (Wikipedia)

Mechanically scanned colour television was demonstrated by Bell Laboratories in June 1929 using three complete systems of photoelectric cells, amplifiers, glow-tubes, and colour filters, with a series of mirrors to superimpose the red, green, and blue images into one full colour image.

15. In 2005 the space probe Cassini arrived to orbit the planet Saturn. Before doing so it launched a small probe onto Saturn's largest moon Titan. The name of this smaller probe was:

    A. Newton,
    B. Cassini II
    C. Huygens
    D. Bessel

Answer C (Wikipedia)

Cassini–Huygens is a joint NASA/ESA/ASI robotic spacecraft mission currently studying the planet Saturn and its moons. The

spacecraft consists of two main elements: the NASA Cassini orbiter, named after the Italian-French astronomer Giovanni Domenico Cassini, and the ESA Huygens probe, named after the Dutch astronomer, mathematician and physicist Christiaan Huygens. It was launched on October 15, 1997 and entered into orbit around Saturn on July 1, 2004. On December 25, 2004 the Huygens probe separated from the orbiter at approximately 02:00 UTC, as confirmed by the Jet Propulsion Laboratory. It reached Saturn's moon Titan on January 14, 2005, where it made an atmospheric descent to the surface and relayed scientific information. It is the first spacecraft to orbit Saturn and the fourth to visit Saturn. Because of Saturn's distance from the Sun, solar arrays were not feasible power sources for the spacecraft. To generate enough power, such arrays would have been too large and heavy. Instead, the *Cassini* orbiter is powered by three radioisotope thermoelectric generators (RTGs), which use heat from the natural decay of plutonium (in the form of plutonium dioxide) to generate direct current electricity. The RTGs have the same design as those on the *Galileo* and *Ulysses* spacecrafts and are designed to have a long operational lifetime. At the end of the 11-year Cassini mission, they will still be able to produce at least 628 watts of power. One of Cassini's spare RTGs was used to power the New Horizons mission to Pluto. The use of 32.8 kg of plutonium—the most launched into space until then—attracted significant protest from environmental groups, physicists, and some former NASA staff.

16. Where was the world's first heart transplant performed?

    A. Groote Schuur hospital in Cape Town, South Africa
    B. St Thomas's hospital, London, England
    C. Johns Hopkins hospital, Baltimore, US.
    D. Red Cross Children's hospital, Cape Town, South Africa.

Answer A (Encyclopaedia Britannica)

A heart transplant is a medical procedure involving the removal of a diseased heart from a patient and its replacement with a healthy heart. Because of the immense complexity of the procedure and the difficulty of finding appropriate donors, heart transplants are performed only as a last resort in patients with end-stage heart failure or irreparable heart damage whose projected survival with their own heart is only a few weeks or months. In most cases, transplanted hearts are taken from persons who have suffered irreversible brain damage and have been declared legally dead but whose organs have been kept artificially viable for the purposes of transplant.

The first heart transplant in an experimental model was performed by French surgeon Alexis Carrel in 1905. American surgeon Norman Shumway achieved the first successful heart transplant in a dog in 1958. In 1967, South African surgeon Christiaan Barnard performed the first human heart transplant. His success was followed by attempts at many other medical centres, but lack of adequate therapy to combat immune rejection of the transplanted heart led most

surgeons to abandon the procedure after the initial attempts. Barnard, Shumway, and some others, however, continued to perform heart transplants, and in the 1970s cyclosporine, a compound isolated from an earth fungus, was discovered to be a very effective drug for combating rejection. Cyclosporine brought about a rapid and successful increase in the number of heart transplant procedures. The survival rate at one year is now about 84 percent and at three years about 77 percent. Many heart transplant patients are able to lead productive lives for years after the procedure.

Heart transplant actually occurs in several stages. First comes the selection and care of the transplant candidate. Patients with end-stage heart failure are acutely ill and require extraordinary support, often including mechanical circulatory assistance or the placement of devices that support the circulation. The second stage is the harvesting of the donor heart (frequently at a remote site) and timely implantation of the heart in the recipient. Both processes mount significant challenges. Current implantation procedure involves removal of the diseased heart except for some of the tissue from the atria, the two upper chambers of the heart. Leaving this tissue in place preserves nerve connections to the sinoatrial node, a patch of electroconductive tissue that regulates heartbeat. The replacement heart is removed from the donor and preserved in a cold salt solution. During implantation it is trimmed to fit and sutured into place, making all necessary vascular connections. The third stage of heart transplant is the postoperative period, which is directed toward providing adequate anti-rejection treatment with close monitoring to prevent rejection of the heart. Medical therapy “trains” the immune system to cope with a foreign heart, but patients require lifelong immune suppression. Indeed, a successful transplant is very demanding on the patient and requires close follow-up, especially during the first year, to decrease the risk of rejection and prevent infections associated with immune suppression. Partly for this reason, it is an extraordinary option for those who are very ill and have no other alternative. Heart transplant is not a cure for heart failure but is a new condition in which the recipient gains new life and functional capacity, though with the commitment to maintain lifelong medical treatment to prevent rejection and infection.

17. South Africa’s new jet fighter planes are:

A. Grippens
B. Sabres
C. Tomcats
D. Cheetahs

Answer A (Wikipedia)

The Saab JAS 39 "Gripen" (*Griffin* or "Gryphon”, see picture below) is a fighter aircraft manufactured by the Swedish aerospace company Saab. The aircraft is in service with the Swedish Air Force, the Czech Republic Air Force and the Hungarian Air Force, and has been ordered by the South African Air Force. In April 2007, Norway signed an agreement on a joint development programme of the aircraft.

Gripen International acts as a prime contracting organisation and is responsible for marketing, selling and supporting the Gripen fighter around the world.

18. Salicylic Acid is used in the making of:

A. dishwashing liquid and detergents,
B. aspirin
C. metallic polishes
D. adhesives (glues)

Answer B

Salicylic acid (from the Latin word for the willow tree, *Salix* from whose bark it can be obtained) is a beta hydroxy acid (BHA) with the formula $C_6H_4(OH)CO_2H$, where the OH group is adjacent to the carboxyl group. This colorless crystalline organic acid is widely used in organic synthesis and functions as a plant hormone. It is derived from the metabolism of salicin. It is probably best known as a compound that is chemically similar but not identical to the active component of aspirin. Aspirin (acetylsalicylic acid or ASA) can be prepared by the esterification of the phenolic hydroxyl group of salicylic acid.

19. The sky is blue and many sunsets are red. This is because of the:

A. refraction of light
B. reflection of light from the sea
C. scattering of light
D. Sun's light is blue and changes colour when it is reflected off objects

Answer C (Wikipedia)

The sky is the part of the atmosphere or of outer space visible from the surface of any astronomical object. It is difficult to define precisely for several reasons. During daylight the sky of Earth has the appearance of a deep blue surface, as the result of the air's scattering of sunlight.[1][2][3][4] The sky is sometimes defined as the denser gaseous zone of a planet's atmosphere. At night the sky has the appearance of a black surface or region scattered with stars.

During the day the Sun can be seen in the sky, unless covered by clouds. In the night sky (and to some extent during the day) the moon, planets and stars are visible in the sky. Some of the natural phenomena seen in the sky are clouds, rainbows, and auroras. Lightning and precipitation can also be seen in the sky during storms. On Earth, birds, insects, aircraft, and kites are often considered to fly in the sky. As a result of human activities, smog during the day and

light radiance during the night are often seen above large cities (see also light pollution).
In the field of astronomy, the sky is also called the celestial sphere. This is an imaginary dome where the sun, stars, planets, and the moon are seen to be travelling. The celestial sphere is divided into regions called constellations.

20. What do the letters “AIDS” stand for in HIV/AIDS?

    A. Anti Immune Disease Syndrome
    B. Anti Immunization Disease System
    C. Age Induced Diabetic Symptom
    D. Acquired Immune Deficiency Syndrome

Answer D

Acquired immune deficiency syndrome or acquired immunodeficiency syndrome (AIDS or Aids) is a collection of symptoms and infections resulting from the specific damage to the immune system caused by the human immunodeficiency virus (HIV) in humans, and similar viruses in other species (SIV, FIV, etc.). The late stage of the condition leaves individuals susceptible to opportunistic infections and tumours. Although treatments for AIDS and HIV exist to slow the virus' progression, there is no known cure. HIV, et al., are transmitted through direct contact of a mucous membrane or the bloodstream with a bodily fluid containing HIV, such as blood, semen, vaginal fluid, preseminal fluid, and breast milk. This transmission can come in the form of anal, vaginal or oral sex, blood transfusion, contaminated hypodermic needles, exchange between mother and baby during pregnancy, childbirth, or breastfeeding, or other exposure to one of the above bodily fluids.

21. The two small robotic rovers, Spirit and Opportunity that surveyed Mars for over two years were powered by:

    A. fuel cells
    B. a small nuclear reactor
    C. solar cells
    D. wind charged batteries

Answer C (Wikipedia)

MER-A (Mars Exploration Rover - A), known as *Spirit*, is the first of the two rovers of NASA's Mars Exploration Rover Mission. It landed successfully on Mars on 04:35 Ground UTC on January 4, 2004, three weeks before its twin *Opportunity* (MER-B) landed on the other side of the planet. Its name was chosen through a NASA-sponsored student essay competition. The rover has continued to function effectively over thirteen times longer than NASA planners expected, allowing it to perform extensive geological analysis of Martian rocks and planetary surface features; as of 2007 its mission is ongoing. Initial scientific results from the first phase of the mission (roughly, the 90-sol prime mission) were published in a special issue of the journal *Science (2004, Volume 305*, issue 5685, pp 737-900). *Opportunity* (and its twin, *Spirit*) are six-wheeled, solar-powered robots standing 1.5 m (4.9 ft) high, 2.3 m (7.5 ft) wide and 1.6 m (5.2 ft) long and weighing 180 kg (400 lb). Six wheels on a rocker-bogie system enable mobility over rough

terrain. Each wheel has its own motor, the vehicle is steered at front and rear and is designed to operate safely at tilts of up to 30 degrees. Maximum speed is 50 mm/s (2 in/s) although average speed is about a fifth of this.

22. Bronze is an alloy (mixture) of which two metals:

    A. copper and iron
    B. copper and zinc
    C. copper and tin
    D. copper and lead

Answer C

Bronze is an alloy traditionally composed of copper and tin. Bronze is of exceptional historical interest and still finds wide applications. It was made before 3000 BC, though its use in artifacts did not become common until much later. The proportions of copper and tin varied widely (from 67 to 95 percent copper in surviving artifacts), but, by the Middle Ages in Europe, certain proportions were known to yield specific properties. An alloy described in an 11th-century Greek manuscript in the library of St. Mark's, Venice, cites a proportion of one pound copper to two ounces of tin (8 to 1) approximately that used for bronze gunmetal in later times. Some modern bronzes contain no tin at all, substituting other metals such as aluminum, manganese, and even zinc.

Bronze is harder than copper as a result of alloying that metal with tin or other metals. Bronze is also more fusible (*i.e.,* more readily melted) and is hence easier to cast. It is also harder than pure iron and far more resistant to corrosion. The substitution of iron for bronze in tools and weapons from about 1000 BC was the result of iron's abundance compared to copper and tin rather than any inherent advantages of iron. Bell metal, characterized by its sonorous quality when struck, is a bronze with a high tin content of 20–25 percent. Statuary bronze, with a tin content of less than 10 percent and an admixture of zinc and lead, is technically a brass.

Bronze is improved in hardness and strength by the addition of a small amount of phosphorus; phosphor bronze may contain 1 or 2 percent phosphorus in the ingot and a mere trace after casting, but its strength is nonetheless enhanced for such applications as pump plungers, valves, and bushings. Also useful in mechanical engineering are manganese bronzes, in which there may be little or no tin but considerable amounts of zinc and up to 4.5 percent manganese. Aluminum bronzes, containing up to 16 percent aluminum and small amounts of other metals such as iron or nickel, are especially strong and corrosion-resistant; they are cast or wrought into pipe fittings, pumps, gears, ship propellers, and turbine blades. Besides its traditional use in weapons and tools, bronze has also been widely used in coinage; most “copper” coins are actually bronze, typically with about 4 percent tin and 1 percent zinc.

23. What is the world’s oldest and largest meteor crater and where is it found?

    A. The Chicxulub crater in the Yucatan Peninsula, Mexico
    B. The Barringer crater in Arizona, USA,

C. The Hoba meteor and crater outside Grootfontein, Namibia,
D. The Vredefort Dome near Parys in SA.

Answer D (Wikipedia)

Vredefort crater is the largest *verified* impact crater on Earth. It is located in the Free State Province of South Africa, and named after the town of Vredefort, which is situated near its centre. The site is also referred to as Vredefort dome or Vredefort impact structure. In 2005, the Vredefort Dome was added to the list of UNESCO World Heritage Sites for its geologic interest. The asteroid that hit Vredefort is one of the largest to ever impact Earth, estimated at over 10 km (6 miles) wide, although it is believed by many that the original size of the impact structure could have been 250 km in diameter, or possibly larger. This makes Vredefort the largest known impact structure on Earth (though the Wilkes Land crater in Antarctica, if confirmed to have been the result of an impact event, is even larger at 500 kilometers across). The crater has a diameter of roughly 300 km (186 miles), larger than the 250 km (155 miles) Sudbury Basin, and the 170 km (106 miles) Chicxulub crater. The age is estimated to be over 2 billion years (2023 ± 4 million years), impacting during the Paleoproterozoic era. It is the second oldest known crater on the Earth, a little less than three hundred millions years younger than the Suavjärvi crater in Russia.

24. Radar speed traps use a phenomena discovered by:

A. Archimedes
B. Bernoulli
C. Döppler
D. Einstein

Answer C (Wikipedia)

Radar is a system that uses electromagnetic waves to identify the range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, motor vehicles, weather formations, and terrain. A transmitter emits radio waves, which are reflected by the target and detected by a receiver, typically in the same location as the transmitter. Although the radio signal returned is usually very weak, radio signals can easily be amplified. This enables a radar to detect objects at ranges where other emissions, such as sound or visible light, would be too weak to detect. Radar is used in many contexts, including meteorological detection of precipitation, air traffic control, police detection of speeding traffic, and by the military. It was originally called RDF (Radio Direction Finder) in Britain. The term *RADAR* was coined in 1941 as an acronym for Radio Detection and Ranging. The term has since entered the English language as a standard word, *radar*, losing the capitalization in the process.

Doppler radar uses the Doppler effect to measure the radial velocity of targets in the antenna's directional beam. The Doppler effect shifts the received frequency up or down based on the radial velocity of target (closing or opening) in the beam, allowing for the direct and highly accurate measurement of target velocity. The phenomenon known as the Doppler Effect is named after Christian Andreas Doppler.

Doppler was an Austrian physicist who first described in 1842, how the observed frequency of light and sound waves was affected by the relative motion of the source and the detector.

This is most often demonstrated by the change in the sound wave of a passing train. The sound of the train whistle will become "higher" in pitch as it approaches and "lower" in pitch as it moves away. This is explained as follows: the number of sound waves reaching the ear in a given amount of time (this is called the frequency) determines the tone, or pitch, perceived. The tone remains the same as long as you are not moving. As the train moves closer to you the number of sound waves reaching your ear in a given amount of time increases. Thus, the pitch increases. As the train moves away from you the opposite happens.

25. The soya bean is a valuable source of

A. plant oil
B. protein
C. sucrose
D. vitamin A

Answer (Encyclopaedia Britannica)

Soybean, also called Soja Bean, or Soya Bean, is an annual legume of the Fabaceae family and its edible seed, probably derived from a wild plant of East Asia. The soybean is economically the most important bean in the world, providing vegetable protein for millions of people and ingredients for hundreds of chemical products.

The origins of the soybean plant are obscure, but many botanists believe it to have derived from *Glycine ussuriensis,* a legume native to central China. The soybean has been used in China for 5,000 years as a food and a component of medicines. Soybeans were introduced into the United States in 1804 and became particularly important in the South and Midwest in the mid-20th century.

The most nutritious and most easily digested food of the bean family, the soybean is one of the richest and cheapest sources of protein. It is a staple in the diet of people and animals in numerous parts of the world today. The seed contains 17 percent oil and 63 percent meal, 50 percent of which is protein. Because soybeans contain no starch, they are a good source of protein for diabetics. In East Asia the bean is extensively consumed in the forms of soybean milk, a whitish liquid suspension, and tofu, a curd somewhat resembling cottage cheese. Soybeans are also sprouted for use as a salad ingredient or as a vegetable and may be eaten roasted as a snack food. Soy sauce, a salty brown liquid, is produced from crushed soybeans and wheat that undergo yeast fermentation in salt water for six months to a year or more; it is a ubiquitous ingredient in Asian cooking.

The soybean is an erect, branching plant ranging in height from several centimeters to more than 2 m (6.5 feet). The self-fertilizing flowers are white or a shade of purple. Seeds can be yellow, green, brown, black, or bicoloured. Modern research has led to a remarkable variety of uses for the soybean. Its oil can be processed into margarine, shortening, and vegetarian cheeses. Industrially, the oil is used as an ingredient

in paints, adhesives, fertilizers, sizing for cloth, linoleum backing, insect sprays, and fire extinguisher fluids, among other products.

Soybean meal serves as a high-protein meat substitute in many food products, including baby foods, and can be imparted with a meat-like texture for increasing the cooked yield of such products as ground meat and bologna. In the late 20th century, the versatile, nutritious soybean, widely cultivable and readily exportable, played an integral role in attempts to alleviate world hunger.

26. The WEHAB AGENDA is a framework for action on water, energy, health, agriculture and biodiversity that came out of the _____held in Johannesburg, 26 August to 4 September 2002.

    A. Rio De Janeiro Summit
    B. World Summit on Sustainable Development (WSSD)
    C. Stockholm Summit
    D. Earth Summit II

Answer B (Wikipedia)

The World Summit on Sustainable Development, WSSD or Earth Summit 2002 took place in Johannesburg, South Africa, from 26 August to 4 September 2002. It was convened to discuss sustainable development by the United Nations. WSSD gathered a number of leaders from business and non-governmental organizations, 10 years after the first Earth Summit in Rio de Janeiro. (It was therefore also informally nicknamed "Rio+10".)

27. The 2002 Johannesburg Summit broadened the vision of sustainable development and re-affirmed the educational objectives of the Millennium Development. The Summit proposed the period 2005 to 2014 as the United Nations _____.

    A. Decade of Education for Sustainable Development
    B. Decade of Education for all
    C. Decade of the Environment and Development
    D. Decade of Education for Women

Answer A (UNESCO)

UN Decade for Education for Sustainable Development (2005-2014)

There can be few more pressing and critical goals for the future of humankind than to ensure steady improvement in the quality of life for this and future generations, in a way that respects our common heritage – the planet we live on. As people we seek positive change for ourselves, our children and grandchildren; we must do it in ways that respect the right of all to do so. To do this we must learn constantly – about ourselves, our potential, our limitations, our relationships, our society, our environment, our world.

Education for sustainable development is a life-wide and lifelong endeavour which challenges individuals, institutions and

societies to view tomorrow as a day that belongs to all of us, or it will not belong to anyone. The United Nations Conference on the Human Environment in Stockholm in 1972, helped to focus attention on environmental concerns and in the years following the conference, the global community acknowledged that more exploration was needed of the inter-relationships between the environment and socio-economic issues of poverty and underdevelopment. Thus the concept of sustainable development emerged in the 1980s in response to a growing realisation of the need to balance economic and social progress with concern for the environment and the stewardship of natural resources.

The concept gained worldwide momentum with the publication of Our Common Future by the World Commission on Environment and Development in 1987. The Commission defined sustainable development in the publication as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This definition considers that while development may be essential to satisfy human needs and improve quality of life, it should occur in such a way that the capacity of the natural environment to meet present and future needs is not compromised. The publication Caring for the Earth: A Strategy for Sustainable Living by the World Conservation Union (IUCN), the United Nations Environment Programme and the World Wide Fund For Nature (WWF) in 1991, document contains a definition of sustainable development which complements the one from Our Common Future. It defined sustainable development as "improving the quality of human life while living within the carrying capacity of supporting ecosystems.

The Brundtland Commission definition emphasizes meeting human needs in a manner that respects intergenerational responsibility and the IUCN definition emphasizes improving the quality of human life while protecting the Earth's capacity for regeneration. The two definitions together give a good understanding of the meaning of sustainable development as benefiting both people and ecosystems.

The UN Conference on Environment and Development in 1992, the Earth Summit, gave high priority in its Agenda 21 to the role of education in pursuing the kind of development that would respect and nurture the natural environment. It focused on the process of orienting and re-orienting education in order to foster values and attitudes of respect for the environment and envisaged ways and means of doing so. By the time of the Johannesburg Summit in 2002 the vision broadened to encompass social justice and the fight against poverty as key principles of development that is sustainable. The human and social aspects of sustainable development meant that solidarity, equity, partnership and cooperation were as crucial as scientific approaches to environmental protection. Besides re-affirming the educational objectives of the Millennium Development Goals and the Education for All Dakar Framework for Action, the Summit proposed the Decade of Education for Sustainable Development as a way of signalling that

education and learning lie at the heart of approaches to sustainable development.

Chapter 36 of Agenda 21 emphasized that education is critical for promoting sustainable development and improving capacity of the people to address environment and development issues. Ever since sustainable development has been a common concern in all UN conferences and there has been a common consensus that education is a driving force for the change needed. It has also been pointed out that peace, health and democracy are mutually reinforcing prerequisites for sustainable development.

The 2002 Johannesburg Summit broadened the vision of sustainable development and re-affirmed the educational objectives of the Millennium Development Goals and the Education for All Dakar Framework for Action, the Summit proposed the Decade of Education for Sustainable Development and the United Nations General Assembly in its 57th Session in December 2002, proclaimed the Decade of Education for Sustainable Development for the period 2005 – 2014.

As the United Nations lead agency in education, UNESCO must play a key role in setting quality standards in education for sustainable development. It needs to reorient its own programmes to include the changes required to promote sustainable development. Improving the quality of education and reorienting its goals to recognize the importance of sustainable development must be one of UNESCO's and the world's highest priorities.

28. Jelly fish numbers can be used to predict weather patterns in the East three or four months ahead of time. During _____ events, the lakes get warmer and the jellyfish die.

A. El Nina
B. La Nino
C. La Nina
D. De Nino

Answer C (Wikipedia)

El Niño-Southern Oscillation (ENSO) is a global coupled ocean-atmosphere phenomenon. The Pacific ocean signatures, El Niño and La Niña are important temperature fluctuations in surface waters of the tropical Eastern Pacific Ocean. The name El Niño, from the Spanish for "the little boy", refers to the Christ child, because the phenomenon is usually noticed around Christmas time in the Pacific Ocean off the west coast of South America. La Niña subsequently means "the little girl". Their effect on climate in the southern hemisphere is profound.

These effects were first described in 1923 by Sir Gilbert Thomas Walker from whom the Walker circulation, an important aspect of the Pacific ENSO phenomenon, takes its name. The atmospheric signature, the Southern Oscillation (SO) reflects the monthly or seasonal fluctuations in the air pressure difference between Tahiti and Darwin.

The most recent occurrence of El Niño started in September 2006 and lasted until early 2007. El Niño and La Niña are officially

defined as sustained sea surface temperature anomalies of magnitude greater than 0.5℃ across the central tropical Pacific Ocean. Normally, strong winds (called trade winds because they aided sailing ships transporting goods) blow to the west in the Pacific, moving warmer surface water away from North and South America. Simultaneously, cold water from the ocean depths rises to the surface off the west coast of South America. This upwelling brings nutrients to the surface, supporting fisheries and ecosystems in the area.

In an El Niño event, these trade winds die down, causing warmer surface water to accumulate off western North and South America. This leads to increased rainfall, storm activity, and flooding in the Americas (especially the south-western United States and Peru) and drought conditions in Australia and other areas in the western Pacific and the Indian Ocean. Fisheries on the west coasts of North and South America are also seriously affected.

East Africa, including Kenya, Tanzania and the White Nile basin experience, from March to May, wetter than normal conditions. There also are drier than normal conditions from December to February in south-central Africa, mainly in Zambia, Zimbabwe, Mozambique and Botswana. Along the west coast of South America, El Niño reduces the upwelling of cold, nutrient-rich water that sustains large fish populations, which in turn sustain abundant sea birds, whose droppings support the fertilizer industry.

29. *Plasmodium*, the malaria parasites, are carried by _____

A. Female *Culex* mosquitoes
B. Male *Anopheles* mosquitoes
C. Male *Culex* mosquitoes
D. Female *Anopheles* mosquitoes

Answer (Wikipedia)

Malaria is a vector-borne infectious disease caused by protozoan parasites. It is widespread in tropical and subtropical regions, including parts of the Americas, Asia, and Africa. Each year, it causes disease in approximately 650 million people and kills between one and three million, most of them young children in Sub-Saharan Africa. Malaria is commonly-associated with poverty, but is also a cause of poverty and a major hindrance to economic development.

Malaria is one of the most common infectious diseases and an enormous public-health problem. The disease is caused by protozoan parasites of the genus *Plasmodium*. The most serious forms of the disease are caused by *Plasmodium falciparum* and *Plasmodium vivax*, but other related species (*Plasmodium ovale*, *Plasmodium malariae*, and sometimes *Plasmodium knowlesi*) can also infect humans. This group of human-pathogenic *Plasmodium* species is usually referred to as *malaria parasites*.

Malaria parasites are transmitted by female *Anopheles* mosquitoes. The parasites multiply within red blood cells, causing symptoms that include symptoms of anemia (light headedness, shortness of breath, tachycardia etc.), as well as other general symptoms such as fever, chills, nausea, flu-

like illness, and in severe cases, coma and death. Malaria transmission can be reduced by preventing mosquito bites with mosquito nets and insect repellents, or by mosquito control measures such as spraying insecticides inside houses and draining standing water where mosquitoes lay their eggs.

No vaccine is currently available for malaria; preventative drugs must be taken continuously to reduce the risk of infection. These prophylactic drug treatments are often too expensive for most people living in endemic areas. Most adults from endemic areas have a degree of long-term recurrent infection and also of partial resistance; the resistance reduces with time and such adults may become susceptible to severe malaria if they have spent a significant amount of time in non-endemic areas. They are strongly recommended to take full precautions if they return to an endemic area. Malaria infections are treated through the use of antimalarial drugs, such as quinine or artemisinin derivatives, although drug resistance is increasingly common.

30. A simple fact in the fight against AIDS: If each one of the following letters of the alphabet equals the corresponding number as tabulated

a	1	**n**	14
b	2	**o**	15
c	3	**p**	16
d	4	**q**	17
e	5	**r**	18
f	6	**s**	19
g	7	**t**	20
h	8	**u**	21
i	9	**v**	22
j	10	**w**	23
k	11	**x**	24
l	12	**y**	25
m	13	**z**	26

Faithfulness =

6+1+9+20+8+6+21+12+14+14+5+19+19 = 140

Which one of the following actions and attitudes least scores in the control of AIDS and what does it score?

A. Careless = 72
B Education = 92
C. Careless = 82
D. Condomise = 82

Answer

This is the easiest question:

Careless = 3+1+18+5+12+5+19+19 =82.

Education = 5+4+21+3+1+20+9+15+14 = 92.

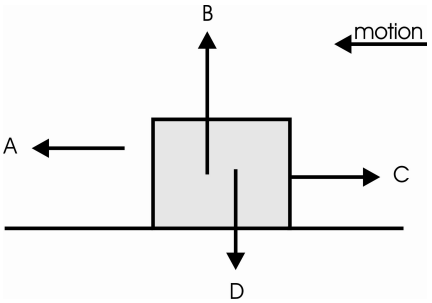
Condomise = 3+15+14+4+15+13+9+19+5 = 97.

The correct answer is C!

SECTION B: PHYSICAL SCIENCE

1. The sketch shows a box being pulled along a horizontal surface at a **constant speed** in the direction shown. Four forces which act on the box are shown.

The **resultant** force acting on the box is

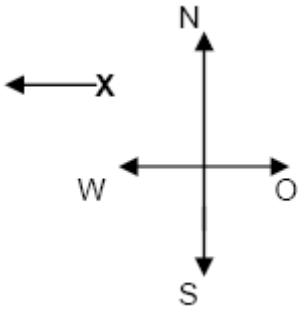


A. in the direction of A
B. in the direction of B
C. zero
D. in the direction of D

Answer C

Since the block is resting on the surface, forces B and D are equal. Also since the block is moving at a constant velocity, a = 0, forces A and C are equal. There is thus no resultant force acting on the block.

2. Point X represents an ant crawling on your question paper in the direction of the arrow.
In which direction must you move the paper (at a suitable speed) such that the displacement of the ant relative to the Earth will be **Northwards**?



A. 

B. 

C. 

D. 

Answer A

One component of the movement must be opposite to the ants speed west. The other component must then be north. The resultant motion musty then be in a north-westerly direction.

3. Two forces of magnitudes 3 N and 5 N act at the same point on an object.
Which one of the following equations Will satisfy the magnitude of the resultant force **R** in newtons:

A. $2 \leq \mathbf{R} \leq 5$
B. $2 \leq \mathbf{R} \leq 8$
C. $3 \leq \mathbf{R} \leq 5$
D. $2 \leq \mathbf{R} \leq 3$

Answer B

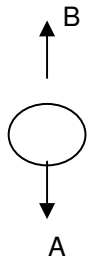
The two extreme situations here are:

1. They act in the same direction, i.e. resultant = 8 N

2. they act in opposite directions, i.e. resultant = 2 N

It is then clear that the resultant must be equal or greater than 2 N and less than or equal to 8 N.

4. The diagram shows the forces acting on a raindrop which is falling to the ground. **A** is the force which causes the raindrop to fall. **B** is the total force opposing the motion of the raindrop. What happens to the raindrop when force **A** = force **B**?

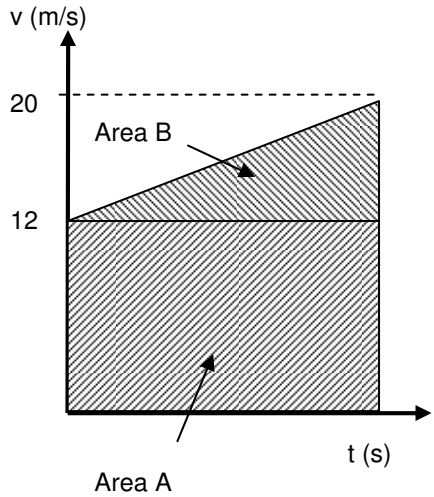


A. It falls to the ground with constant velocity
B. It splits up into two equal parts
C. It remains stationary
D. It falls to the ground with constant acceleration

Answer A

When the drop starts falling A = its weight, and the resistance to motion = 0. As the speed increases, so does the resistance to motion. Eventually A = B, and the drop has reached what is known as its "terminal velocity", which is constant.

5. The velocity-time graph for a car Moving along a straight horizontal road is shown. Which of the following expressions gives the magnitude of the average velocity of the car?



A. Area A / t
B. (Area A + Area B) / t
C. Area B / t
D. (Area A - Area B) / t

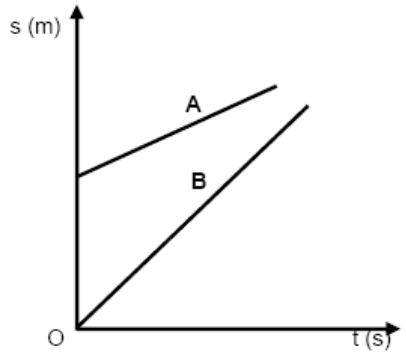
Answer B

The vertical axis represents the velocity (as given in the question) and not the displacement as was initially shown on the diagram. (If you have the original paper).

The magnitude of the average velocity is (total displacement) / (total time), so:

$$V_{AVE} = (\text{Area A} + \text{Area B})/t = 16\ m.s^{-1}$$

6. The motion of two cars, A and B, are represented in the following displacement-time graph.



The graph indicates that

A. **B** is moving faster than **A**
B. **A** and **B** are accelerating uniformly
C. **A** and **B** are on a collision course
D. **A** and **B** started from the same point

Answer A

The slope (gradient) of a s-t graph indicates the speed of an object: the steeper the slope the higher the speed. It is clear that the slope of B > the slope of A, so B is moving faster than A.

7. An object starts moving from a position of rest with a constant acceleration **a**. After it has covered a distance **s**, its velocity is **v**. What will be the magnitude of its velocity after it has covered a distance 2 s?

A. v/2
B. v
C. √2v
D. 2v

Answer C

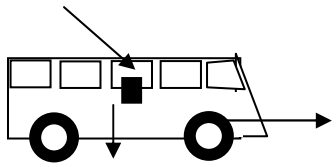
Using the equation: $v^2 = u^2 + 2as$ we have:

For distance s: $v^2 = 2as$ since u = 0

For distance 2s $V^2 = 2a \times 2s = 2 \times 2as = 2 \times v^2$

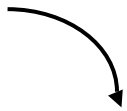
Then if $V^2 = 2v^2 \Rightarrow V = \sqrt{2}\, v$

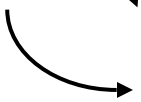
8. Cool drink **can**



Thebe, travelling in a minibus in the direction shown, accidentally drops a cool drink **can** out of the window as shown above. What is the correct path that the **can** takes in falling to the ground?

A. 

B. 

C. 

D. 

Answer B

The can that Thebe dropped has a constant horizontal velocity in the direction that the mini-bus is moving, and an increasing downward speed as a result of the acceleration due to gravity.

Answers C and D cannot be correct. A shows that both the downward and the horizontal speeds are constant, only B shows the correct path.

9. A train is moving slowly on a straight track with a constant speed of 2 m/s. A passenger gets up from his seat and walks at a steady speed of 2 m/s to the back of the train. To an observer standing outside the train, the passenger will appear to be _____

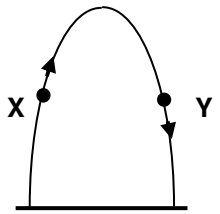
A. moving in the opposite direction to the train at 4 m/s
B. stationary
C. moving in the same direction as the train at 4 m/s
D. moving in the same direction as the train at 2 m/s

Answer B

The relative speed of the passenger to the ground is 2 $m.s^{-1}$ – 2 $m.s^{-1}$ = 0. So to the stationary observer the passenger is also stationary.

10. A ball is thrown vertically upwards and returns to the point of projection.

Which statement about the acceleration At point **X** and **Y** is correct?

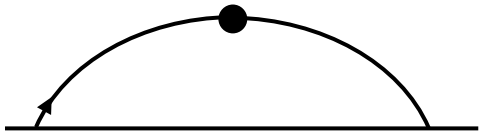


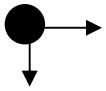
A. The acceleration is downwards at both points
B. The acceleration is upwards at both points
C. The acceleration is downwards at **X** and upwards at **Y**
D. The acceleration is upwards at **X** and downwards at **Y**

Answer A

The only acceleration experienced by the ball is that due to gravity, its weight, which is causing the ball to slow down, i.e. acting downwards at all times.

11. A ball is thrown as shown.
Which one of the following diagrams Best represents the forces acting on the ball when it is at its maximum height?
(Assume air resistance is negligible.)



A. 

B.  no force

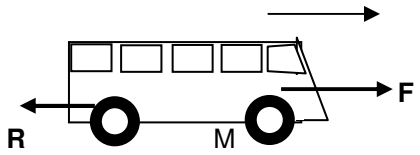
C. 

D. 

Answer D

Since there is no air-resistance the only force acting on the ball is that due to gravity: its weight.

12.



Another minibus of mass M is travelling along a level road at a constant speed as shown above. It covers a distance of 'm' metres in 't' seconds. **F** is the force driving the minibus forwards and **R** is the resistance to motion. The power of the engine is:

A $\frac{m\,s}{t}$

B $\frac{m\,s\,\mathbf{F}}{t}$

C F t

D $\frac{\mathbf{R}\,s}{t}$

Answer D

Power is the rate of doing work, i.e. Power = W/t

Now work = Force x distance = F x s. So Power = (F x s)/t = F x s/t = Force x speed = Fv

The mini-bus is travelling at constant speed so:

F = R (i.e. a = 0), so the Power = R x s/t

13. An iron ball of mass 'm' is dropped from a height of H metres. If it takes 't' seconds for the ball to reach the ground, how long does it take for the ball to lose **half** its Potential Energy, **PE**?

A. $\frac{t}{2}$

B. $\sqrt{\frac{H}{g}}$

C. $\frac{\sqrt{t}}{2}$

D. $\frac{H^2}{2g}$

Answer C

A loss of ½ E_P occurs at H/2. Using s = ut + ½ at^2 it is clear that $s \propto t^2$ or $H \propto t^2$

So the time T for the ball to have fallen H/2 $\propto T^2$ or $H \propto 2T^2$, so $t^2 = 2T^2$ and $t = \sqrt{2}\,T$

$T = t/\sqrt{2}$

14. A cricket ball of mass 'm' is bowled at a batsman and gets to the bat travelling at V $m.s^{-1}$.
The batsman hits the ball and it leaves his bat after 't' seconds at a speed of V/2 $m.s^{-1}$. The magnitude of the force on the ball in newtons is:

A. $\frac{m\,V}{2\,t}$

B. $\frac{2\,m}{3\,V\,t}$

C. $\frac{2\,m\,V}{t}$

D. $\frac{3\,m\,V}{2\,t}$

Answer D

Force is then rate of change of momentum, P, i.e.

$F = \Delta mv/t = \Delta P/t$.

Now the change in momentum is the difference between the initial and final momentum: $P_F - P_I = mV - (-mV/2) = 3mV/2$.

This change took place in t seconds so $F = 3mV/2t$

15. A truck of mass 'M' has brakes that can supply a maximum force of F newtons on the road. This enables the truck to stop in a **minimum** distance of 'D' metres when travelling at a speed of V $m.s^{-1}$. What is the **minimum** distance the truck can stop in, if it is travelling at 2V $m.s^{-1}$?

    A. $\sqrt{2D}$
    B. $\sqrt{2}.D$
    C. 2 D
    D. 4 D

Answer D

Using $v^2 = u^2 + 2as$, we have for the truck:

$0 = V^2 - 2aD$. Truck comes to rest (v = 0).

So $V^2 = 2aD$

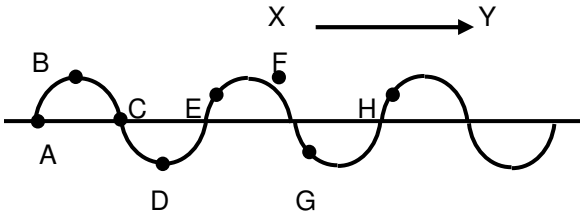
Now if the initial speed is 2V, then we get

$(2V)^2 = 2ad$ or $4V^2 = 2ad$.

But $V^2 = 2aD$, so $4\ (2aD) = 2ad$ or $8aD = 2ad$

This means that d = 4D.

Questions 46 and 47 refer to the diagram which shows the profile of a transverse wave.



16. The distance which represents one wavelength is

    A. AC
    B. BD
    C. EH
    D. EF

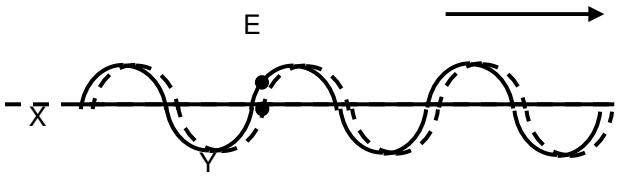
Answer C

Pure recall! Find two points on adjacent waves that are doing the same thing at the same time. Points E and H.

17. If the arrow XY represents the direction in which the energy is being propagated, the direction of the motion of point E at the instant shown is

    A. ↓
    B. ↑
    C. →
    D. ↗

Answer A



The dotted wave-train shows the same wave a short interval of time later, and since it is a

transverse wave the point E moves vertically up down: i.e. perpendicular to XY. It is clear that E has moved downwards.

18. When monochromatic light is totally reflected by a mirror, which of the properties of the light stay(s) the same after reflection?

A. Speed only
B. Frequency only
C. Photon energy only
D. Speed, frequency and photon energy

Answer D

Since the light is totally reflected there is no change of energy. Frequency is proportional to energy and the speed of light in any one medium is constant, so none of the given properties change.

19. When picking up a knife that is lying on a table, the steel blade feels colder than the wooden handle. This is because:

A. steel is a better conductor of heat than wood,
B. wood has a higher specific heat capacity than steel,
C. steel has a higher specific heat capacity than wood,
D. the steel blade is actually colder than the wooden handle.

Answer A

Answer D is obviously wrong. It would take some time for the effects of specific heat capacity to be become noticeable, so B and C are wrong. How cold an object feels depends not only on its temperature but also on its thermal conductivity. The quicker a relatively cool objects conducts heat away from your hand when you grip it the cooler it feels. So "feeling" temperature depends on conductivity.

20. A diver swims obliquely above a fish in water. If he wants to hit the fish, he must aim at a point

.fish

A. above the fish
B. below the fish
C. on the fish
D. to the left of the fish

Answer C

As both the fish and the diver are under water, there are no refraction effects to consider. So providing both diver and fish are either stationary or moving at the same speed (details not supplied, so can be assumed), the diver simply aims directly at the fish. (Note "at" rather than "on")

21. Diamond is optically more dense than water because _____

A. it has a greater density than water
B. water is more transparent
C. water retards the speed of light less than a diamond
D. a diamond glitters more than water

Answer C

Diamonds "sparkle" because they have a high refractive index, which is higher than that of water. This means that the speed of light in a diamond is less than the speed of light in water (which is how the answer should be framed!).

22. Two photons travelling in a vacuum Have different energies. This implies that they necessarily differ in their _____

A. velocity
B. intensity
C. charge
D. frequency

Answer D

The energy of a photon is directly proportional to its frequency ($E = hf$). Photons have no charge, travel at the same velocity if they are both in the same medium, in this case a vacuum, and intensity has nothing to do with it, so the only thing that can differ is their frequency.

23. Which of the following expressions correctly gives the energy, E, of a photon, given that $E = hf$ (h = Planck's constant) and $c = f\lambda$ for a photon:

A. $E = h c \lambda$

B. $E = \frac{f \lambda}{h}$

C. $E = \frac{h \lambda}{c}$

D. $E = \frac{h c}{\lambda}$

Answer D

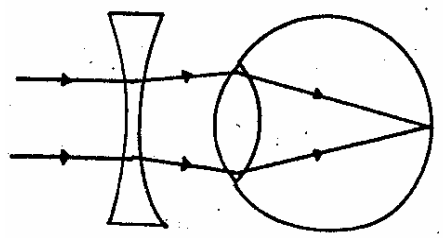
Since $c = f \lambda$,

we have that $f = \frac{c}{\lambda}$

Substituting this into $E = hf$

gives $E = \frac{hc}{\lambda}$

24. The following statement is applicable to the accompanying sketch:



A. The concave lens diminishes the focal length of the eye's lens
B. The concave lens replaces the lens of the eye
C. The concave lens represents the adjustment of a short-sighted eye
D. The concave lens converges the rays that fall in on the eye

Answer C

In this situation the concave, diverging, lens is used to correct the vision of a short sighted person. Recall question.

25. It takes sound approximately 3 s to travel through a distance of 1 km. If you hear the thunder 9 seconds after having seen the lightning flash, the distance between you and the lightning, in km, is

A. 27
B. 9
C. 3
D. 1/3

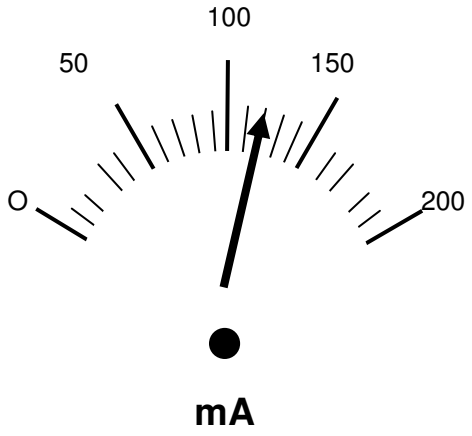
Answer C

Speed = distance/time, so distance = speed x time. It takes 3 s to travel 1 km, speed is ⅓ km/s so the distance travelled in 9 s = ⅓ x 9 = 3 km.

Lightning is an atmospheric discharge of electricity, which typically occurs during thunderstorms, and sometimes during volcanic eruptions or dust storms. A bolt of lightning can travel at a speed of 100000 mph (160934 km/h), and can reach temperatures approaching 28000 °C (60000 °F), hot enough to fuse soil or sand into glass channels. There are over 16 million lightning storms every year.

Lightning can also occur within the ash clouds from volcanic eruptions, or can be caused by violent forest fires which generate sufficient dust to create a static charge. How lightning initially forms is still a matter of debate: Scientists have studied root causes ranging from atmospheric perturbations (wind, humidity, and atmospheric pressure), to the impact of solar wind and accumulation of charged solar particles. Ice inside a cloud is thought to be a key element in lightning development, and may cause a forcible separation of positive and negative charges within the cloud, thus assisting in the formation of lightning.

26. What is the reading on the ammeter shown in the diagram? (The needle is represented by the thick solid line).



A. 120 A
B. 12 A
C. 1, 2 A
D. 0, 12 A

Answer D

The diagram shows a reading of 120 divisions, each of which is 1 mA = 1/1000 A. So the current reading is 120/1000 = 0.12 A.

27. A volt can be defined as

A. coulomb per second
B. ampere per volt
C coulomb per ampere
D joule per coulomb

Answer D

The volt (symbol: V) is the SI derived unit of electric potential difference or electromotive force.[1][2] It is named in honour of the Italian physicist Alessandro Volta (1745–1827), who invented the voltaic pile, the first modern chemical battery. The volt is defined as the potential difference across a conductor when a current of one ampere dissipates one watt of power. Hence, it is the

base SI representation $m^2 \cdot kg \cdot s^{-3} \cdot A^{-1}$, which can be equally represented as one joule of energy per coulomb of charge, J/C.

$$V = \frac{W}{A} = \frac{W \cdot s}{A \cdot s} = \frac{J}{C} = \frac{N \cdot m}{A \cdot s} = \frac{kg \cdot m^2}{A \cdot s^3}$$

28. If a constant current of 2 A flows for 3 minutes in a conductor, the total charge that passes through the conductor is

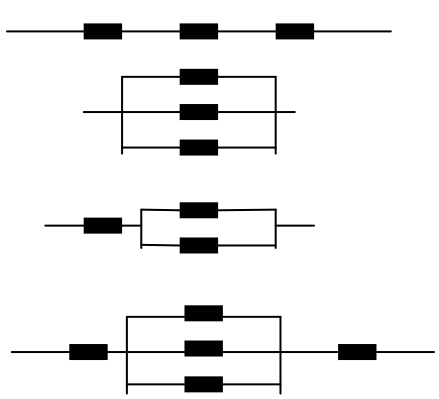
A. 6 C
B. (2/3) C
C. 360 C
D. (3/2) C

Answer C

The current in a conductor can be thought of as coulombs per second, i.e. I = Q/t and so Q = I x t Q = 2 x 3 x 60 C = 360 C.

29. Which arrangement of 3 ohm resistors will give a total resistance of 7 ohms?

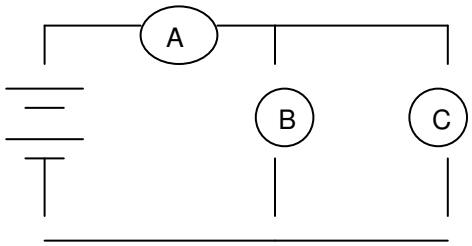
A.
B.
C.
D.



Answer D

A gives 3 + 3 + 3 = 9Ω
B gives 1/R = ⅓ + ⅓ + ⅓ = 1, so R = 1 Ω
C gives 3 + 1 ½ = 4 ½ Ω
D gives 3 + 1 + 3 = 7 Ω

30. Which of the following identical light bulbs will glow the brightest?



A. Bulb A
B. Bulb B only
C. Bulb C only
D. Bulbs B and C

Answer A

All the bulbs are identical, so the brightest will have the highest PD across it giving the highest current through it. Then since B and C are in parallel, each of their currents flow through A, so A is brightest.
Alternatively the PD across the parallel combination is ½ that across A, so A is brightest.

31. The core of an electromagnet is made of

A. steel
B. iron
C. air
D. copper

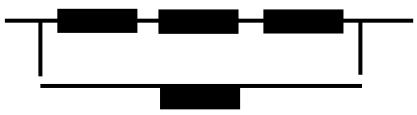
Answer B

Recall. Needs to be a magnetic material, so either A or B are possible. Steel quickly becomes a permanent magnet, so B is correct.

An electromagnet is a type of magnet in which the magnetic field is produced by the flow of an electric current. The magnetic field disappears when the current ceases. British electrician William Sturgeon invented the electromagnet in 1825. The simplest type of electromagnet is a coiled piece of wire. A coil forming the shape of a straight tube (similar to a corkscrew) is called a solenoid; a solenoid that is bent so that the ends meet is a toroid. Much stronger magnetic fields can be produced if a "core" of paramagnetic or ferromagnetic material (commonly soft iron) is placed inside the coil. The core concentrates the magnetic field that can then be much stronger than that of the coil itself.

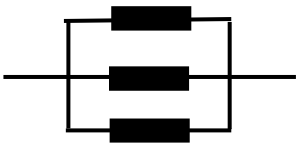
32. All the resistors below have the same resistance. Which of the combinations below has the least resistance?

A

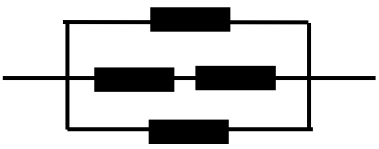


B

C



D



Answer C

If each resistor has resistance of r Ω, then the total resistance for:

A = ¾ r Ω; B = ½ r Ω; C = ⅓ Ω; D 2/5 r Ω.

33. Eight standard torch cells of 1.5 V are connected in series to give a potential difference of 12 V, the same as that of a car's lead-acid battery. The car battery can supply a current very much higher than the eight cells connected in series. This is because it:

A. is bigger,
B. has a larger power,
C. has a much smaller internal resistance,
D. stores more energy.

Answer C

The maximum current that a battery can supply depends on the total internal resistance of the cells that make it up. Torch cells have a higher internal resistance than lead-acid cells, so C is the correct answer.

34. A helium nucleus, or α-particle, and an electron have the same kinetic energy T. If the speed of the α-particle is 100 $m.s^{-1}$, the approximate speed of the electron is nearly, in $m.s^{-1}$?

A. 200
B. 400
C. 900
D. 9 000

Answer D

$E_K = T = ½ m v^2$. Now the mass of a nucleon (proton or neutron) is about 1860 times that of an electron. So
$T_e = ½ m_e V^2$ and $T_\alpha = ½ \times 4 \times 1860 \times (100)^2$
$= ½ \times 7440 m_e \times 10^4$. But $T_e = T_\alpha$ so
$½ m_e V^2 = ½ \times 7440 m_e \times 10^4$. ie $V^2 = 7440 \times 10^4$ so $V = 8625\ m.s^{-1}$

35. If the two particles in Question 64 above were accelerated through the same potential difference V, the kinetic energy of the α-particle would be
    A. 4 times,
    B. 2 times,
    C. $\sqrt{2}$ times,
    D. the same as that of the electron.

Answer D

If charged particles are accelerated through the same potential difference, they will all have the same kinetic energy, E_K . Their speed may well differ since they could have different masses.

SAASTA

SOUTH AFRICAN AGENCY FOR SCIENCE AND TECHNOLOGY ADVANCEMENT

For more information:

Tel: +27 12 392 9300
Fax: +27 12 320 7803
Email: scienceolympiad@saasta.ac.za
Web: www.saasta.ac.za