READING PASSAGE 1

You should spend about 20 minutes on ***Questions 1 – 13*** *which are based on Reading Passage 1 below.*

The Geodesic Dome - The House of The Future?

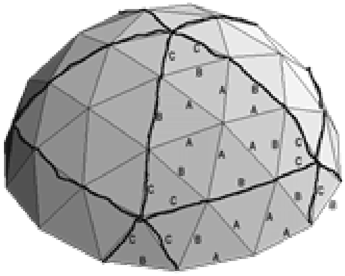
R. Buckminster Fuller spent much of the early 20th Century looking for ways to improve human shelter by applying modern technological know-how to shelter construction, making shelter more comfortable and efficient, and more economically available to a greater number of people.

After acquiring some experience in the building industry and discovering the traditional practices and perceptions which severely limit changes and improvements in construction practices, Fuller carefully examined, and improved, interior structure equipment, including the toilet, the shower, and the bathroom as a whole. He studied structure shells, and devised a number of alternatives, each less expensive, lighter, and stronger than traditional wood, brick, and stone buildings.

In 1944, the United States suffered a serious housing shortage. Government officials knew that Fuller had developed a prototype of family dwelling which could be produced rapidly, using the same equipment which had previously built war-time airplanes. They could be "installed" anywhere, the way a telephone is installed, and with little additional difficulty. When one official flew to Wichita, Kansas to see this house, which Beech Aircraft and Fuller built, the man reportedly gasped, "My God! This is the house of the future!"

Soon, unsolicited checks poured in from people who wanted to purchase this new kind of house, but Fuller was never able to get it into full production. This was due to many obstacles such as only union contractors were able to hook the houses up to water, power and sewers in many cities. However, because the houses were already wired and had the plumbing installed by the aircraft company, many construction trade unions made it clear that they would not work on the houses. There were also in-house differences between Fuller and the stockholders. Fuller did not feel the house design was complete; there were problems he wanted to fix. But the stockholders wanted to move ahead. However, the main obstruction was obtaining the financing for the tooling costs, which were purposefully not included in the negotiations with investors. No bank would finance the project with union problems and stockholder battles.

After the war, Fuller's efforts focused on the problem of how to build a shelter which is so lightweight, it can be delivered by air. Shelter should be mobile which would require great breakthroughs in the weight-reduction of the materials. Technology would have to follow nature's design as seen by the spider's web which can float in a hurricane because of its high strength-to-weight ratio. New shelter would have to be designed that incorporates these principles and that was Fuller's intent.



One of the ways Buckminster Fuller would describe the differences in strength between a rectangle and a triangle would be to apply pressure to both structures. The rectangle would fold up and be unstable but the triangle withstands the pressure and is much more rigid --- in fact the triangle is twice as strong. This principle directed his studies toward creating a new architectural design, the geodesic dome, based also upon his idea of "doing more with less." Fuller discovered that if a spherical structure was created from triangles, it would have unparalleled strength.

The sphere uses the "doing more with less" principle in that it encloses the largest volume of interior space with the least amount of surface area thus saving on materials and cost. Fuller reintroduced the idea that when the sphere's diameter is doubled it will quadruple its square footage and produce eight times the volume.

The spherical structure of a dome is one of the most efficient interior atmospheres for human dwellings because air and energy are allowed to circulate without obstruction. This enables heating and cooling to occur naturally. Geodesic shelters have been built all around the world in different climates and temperatures and still they have proven to be the most efficient human shelter one can find.

More specifically, the dome is energy efficient for many reasons: its decreased surface area requires less building materials; exposure to cold in the winter and heat in the summer is decreased because, being spherical, there is the least surface area per unity of volume per structure; the concave interior creates a natural airflow that allows the hot or cool air to flow evenly throughout the dome with the help of return air ducts; extreme wind turbulence is lessened because the winds that contribute to heat loss flow smoothly around the dome; it acts like a type of giant down-pointing headlight reflector and reflects and concentrates interior heat. This helps prevent radiant heat loss.

The net annual energy savings for a dome owner is 30% less than normal rectilinear homes according to the Oregon Dome Co. This is quite an improvement and helps save the environment from wasted energy. Domes have been designed by Fuller and others to withstand high winds and extreme temperatures as seen in the Polar Regions.

Many dome manufacturers offer various designs in geodesic dome housing with little assembly time required. Some houses can be assembled in less than a day with others taking up to six months. Many also come in dome kits that buyers can build themselves or with the help of friends.

R. Buckminster Fuller’s first worldwide acceptance by the architectural community occurred with the 1954 Triennale where his cardboard dome was displayed for the first time. The Milan Triennale was established to stage international exhibitions aimed to present the most innovative accomplishments in the fields of design, crafts, architecture and city planning.

The theme for 1954 was Life Between Artifact and Nature: Design and the Environmental Challenge, which fit in perfectly with Fuller’s work. Fuller had begun efforts towards the development of a Comprehensive Anticipatory Design Science, which he defined as, "the effective application of the principles of science to the conscious design of our total environment in order to help make the Earth’s finite resources meet the needs of all humanity without disrupting the ecological processes of the planet." The cardboard shelter that was part of his exhibit could be easily shipped and assembled with the directions printed right on the cardboard. The 42-foot paperboard Geodesic was installed in old Sforza garden in Milan and came away with the highest award, the Gran Premio.

Questions 1 - 2

Choose the appropriate letters A – D and write them in boxes 1 – 2 on your answer sheet.

1. In 1944, government officials were interested in Fuller’s family dwelling because _______
   (A) they had a housing shortage.
   (B) it is the house of the future.
   (C) it could be produced rapidly and installed easily.
   (D) all of the above.

2. Fuller’s family dwelling was not fully produced mainly because _______
   (A) aircraft company installed these houses
   (B) there were financing problems
   (C) union contractors did not support Fuller
   (D) Fuller and the stockholders held different ideas

Questions 3 - 7

Classify the following descriptions as referring to

The sphere	***S***
The rectangle	***R***
The triangle	***T***

Write the appropriate letters in boxes 3 – 7on your answer sheet.
NB *You may use any answer more than once.*

3. doing more than less
4. stable
5. allowing natural air circulation
6. rigid
7. folding

Questions 8 - 13

Do the following statements agree with the information given in Reading Passage 1? In boxes 8 – 13 on your answer sheet write.

TRUE	*if the statement is true*
FALSE	*if the statement is false*
NOT GIVEN	*if the information is not given in the passage*

8. A geodesic dome is basically a spherical structure created from rectangles.
9. It has been proved that the geodesic dome is the most efficient human shelter.
10. Domes are the environment-friendly building.
11. Some scientists set up domes in the Polar Regions.
12. Domes are much cheaper than traditional houses.
13. Fuller won the Gran Premio in 1954.

READING PASSAGE 2

You should spend about 20 minutes on **Questions 14 – 26** *which are based on Reading Passage 2 below.*

Questions 14 - 18

Choose the most suitable headings for paragraphs **B – F** *from the list of headings below.*
Write appropriate numbers (i - x) in boxes 14 – 18 on your answer sheet.

NB *There are more headings than paragraphs, so you will not use them all.*

List of Headings

i.	Clothing symbolising status
ii.	The factors determining the dye's quality
iii.	The invaluable colour
iv.	The importance of plants in ancient times
v.	From family to industry
vi.	The value of colours
vii.	Dyestuff sources in the past
viii.	Availability and durability of a dye
ix.	The competitive and secret industry
x.	Pigments, insoluble colouring materials

Example	*Answer*
Paragraph **G**	x

14. Paragraph **B**
15. Paragraph **C**
16. Paragraph **D**
17. Paragraph **E**
18. Paragraph **F**

Dyes and Pigments

A

Dyeing is a process of colouring materials, or cloth fibers, whereby the colour becomes part of the fiber. The fastness of the colour, or its permanency, depends upon the dye and the process used. True dyeing is a permanent colour change, and the dye is absorbed by, or chemically combined with, the fiber.

B

In ancient times all the dyes used were natural; actually, this was true up until mid-1800. The dyestuffs came from a variety of natural sources, some commonly available, others rare or difficult to produce. Some of the common dyes included logwood or quercitron, fustic, woad, and indigo. An example of the rare dyes would be cochineal and Tyrian purple. Collectively, these substances are called dyestuffs, and were occasionally traded as a commodity. The dyestuffs were extracts from plants, mollusks, insects, woods, or naturally occurring minerals. There are many plants which produce dye suitable in the dyeing process, and many were heavily cultivated. Madder and woad were grown in Europe specifically for their dyeing properties. Saffron was also extensively grown in Anatolia for its yellow dye. Probably one of the most famous dyes was Tyrian purple, from a Mediterranean shellfish. The Phoenicians of Tyre, in Lebanon, produced this very expensive dye long before written history began. Many other areas had special dyes which were famous in antiquity.

C

The value of a dye is not just its availability, but also its fastness or durability against daily use. It must withstand washing, wearing, sunlight, perspiration, without losing an appreciable amount of its colour. The colour, and its brightness, also helped determine the dye's value. Premium colours were purple, blue, and bright shades of red.

D

There are two classifications of dyeing, the home craft and the trade, or industrial, dyeing. The manufacturing of clothing, the spinning, weaving and embroidery, tended to stay within the family unit. An exception to this would be the carpets made in Anatolia and Persia, for example, or the very fine, sheer linen woven in Egypt. But the manufacture of dyes and their use in dyeing yarn and cloth soon became an industry, supporting large numbers of people, even entire cities. The art of dyeing was one of the earliest arts known to man after he became civilized. Trade dyeing was, however, a highly competitive business. These were the professionals of the ancient world when it came to dyed cloth. Many of the processes were closely guarded secrets, and many of the special skills were handed down over generations. The ingredients may come from far away; the tools may be specialized and the process often was steeped in superstition.

E

As far back as man can historically see, rulers have set themselves apart from everyone else by wearing exotic and rare items, and dyed clothing was very early a part of this status proclamation. Still today the important and the wealthy prefer to wear items not available to all. In Egypt, the pharaohs wore specially made clothing, dyed with colours difficult to obtain. Dyed fabrics from tombs of early Egyptian attest to the antiquity of the dyers art.

F

In the ancient Greek and Roman world, Tyrian purple became the colour of choice for rulers and emperors. The dye was extremely expensive, therefore, available to only a few. When in later times merchants, considered unimportant, became wealthy enough to buy purple-dyed cloth, laws were passed to prevent their diluting the impressiveness of the colour. Only rulers, or emperors, were allowed to wear purple. Later, however, the law was changed to include the rulers' family; then senators; and so on, eventually losing its status. This is where the phrase "born to the purple" came from.

G

The word pigment comes from the Latin "pigmentum" meaning coloured material. Pigments are generally distinguished from dyes as colouring materials on the basis of their soluble ability (solubility) characteristics. Pigments are used mainly in the colouration of paints, printing inks and plastics, although they are used to a certain extent in a much wider range of applications including textiles, ceramics, paper, and cosmetics. In contrast to dyes, pigments are highly insoluble colouring materials, which are incorporated into an applications medium by dispersion, and they remain as discrete solid particles held mechanically within a polymeric matrix. Pigments are thus required to resist dissolving in solvents, which they may contact in application to minimize problems such as 'bleeding' and migration. In addition to solvent resistance, pigments are required to be fast to light, weathering, heat and chemicals such as acids and alkalis to a degree dependent on the demands of particular application.

Natural inorganic pigments, derived mainly from mineral sources, have been used as colourants since pre-historic times and a few, notably iron oxides, remain of some significance today. The origins of the synthetic inorganic pigment industry may be traced to the introduction of Prussian blue in the early 18th century, pre-dating the synthetic organic colourant industry by some 150 years. The organic pigments are the oxides, sulfides, hydroxides, silicates, sulfates and carbonates of metals. The colour of a pigment is due to its interactions with light by scattering and absorption.

The synthetic organic pigment industry emerged towards the end of the 19th century out of the established synthetic textile dyestuffs industry. Many of the earliest organic pigment were known as 'lakes'. These products were prepared from established water soluble dyes by precipitation on to an insoluble inorganic substrate. A further significant early development in organic pigments was the introduction of a range of azo pigments. One of the most critical events in the development of the organic pigment industry was the discovery, in 1928, of copper phtalocyanine blue. This was the first pigment to offer the outstanding intensity and brightness of colour typical of organic pigments, combined with an excellence range of fastness properties, comparable with many inorganic pigments. Organic pigments generally provide higher intensity and brightness of colour than inorganic pigments. However, organic pigments are unable to provide the degree of opacity offered by most inorganic pigments which have the lower reflectance.

Questions 19 - 21

Choose the appropriate letters A – D and write them in boxes 19 – 21 on your answer sheet.

19. Among the following dye colours, which one had superior value in the past?
    (A) yellow
    (B) red
    (C) blue
    (D) white

20. The pharaohs wore specially dyed clothing, because ________
    (A) it was difficult to obtain.
    (B) it was exotic and rare.
    (C) it distinguished them.
    (D) it attested to the antiquity of the dyers art.

21. According to the passage, the phrase “born to the purple” describes someone who ________
    (A) has a royal birth
    (B) is very wealthy
    (C) extremely favors the purple colour.
    (D) was born with silver spoon.

Questions 22 - 26

Complete the summary below. Choose ***no more than three words*** *from the passage for*

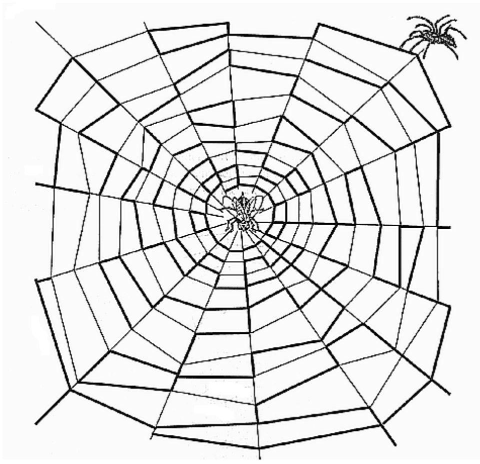
each answer.
Write your answers in boxes 22 – 27on your answer sheet.

As colouring materials, the distinguished characteristic of pigments is that they are more **…(22)…** than dyes, and in the colouring process, dyes are **…(23)…** by the materials, while pigments work by **…(24)…**. Compared with inorganic pigments, organic pigments give colour higher **…(25)…**, but lower **…(26)…**.

READING PASSAGE 3

You should spend about 20 minutes on ***Questions 27 – 40*** *which are based on Reading Passage 3 below.*

Spider Silk



Spider silk is not a single, unique material --- different species produce various kinds of silk. Some possess as many as seven distinct kinds of glands, each of which produces a different silk.

Why so many kinds of silk? Each kind plays particular roles. All spiders make so-called dragline silk that functions in part as a lifeline, enabling the creatures to hang from ceilings. And it serves as a constant connection to the web, facilitating quick escapes from danger. Dragline silk also forms the radial spokes of the web; bridgeline silk is the first strand, by which the web hangs from its support; yet another silk forms the great spiral.

The different silks have unique physical properties such as strength and elasticity, but all are very strong compared to other natural and synthetic materials. Dragline silk combines toughness and strength to an extraordinary degree. A dragline strand is several times stronger than steel, on a weight-for-weight basis, but a spider's dragline is only about one-tenth the diameter of a human hair. The movie *Spider-Man* drastically underestimates the strength of silk --- real dragline silk would not need to be nearly as thick as the strands deployed by the web-swinging hero in the movie.

Dragline silk is a composite material comprised of two different proteins, each containing three types of regions with distinct properties. One of these forms an amorphous (non-crystalline) matrix that is stretchable, giving the silk elasticity. When an insect strikes the web, the stretching of the matrix enables the web to absorb the kinetic energy of the insect's flight. Embedded in the amorphous portions of both proteins are two kinds of crystalline regions that toughen the silk. Although both kinds of crystalline regions are tightly pleated and resist stretching, one of them is rigid. It is thought that the pleats of the less rigid crystals not only fit into the pleats in the rigid crystals but that they also interact with the amorphous areas in the proteins, thus anchoring the rigid crystals to the matrix. The resulting composite is strong, tough, and yet elastic.

Then, why doesn't a spider get stuck on its own web? Over the years, three explanations for this phenomenon have surfaced. The first invokes an oil, secreted by the spider, that serves as an anti-stick agent. The problem with this hypothesis is that such an oil has yet to be discovered.

The second scenario is based on the diversity of silks. Many webs include strands made of silks that are much less sticky than the others are. The non-sticky strands appear in the hub of the web, the radial spokes and the threads by which the web hangs from plants or other supports. Some researchers have thus posited that the arachnids use only these strands when navigating their webs. If you watch them in action, however, you will see that although they do seem to prefer the non-sticky strands, the spiders are able to move around freely, touching many of the strands, including the very sticky ones that spiral out from the hub.

The third explanation appears to solve the sticky-strand problem. In short, the legs of at least some spiders feature a disengaging mechanism that enables the arachnid to detach itself instantly from a sticky strand. This mechanism involves a clever anatomical adaptation. Each leg ends in a pair of "walking claws" that grasp vegetation, among other functions, but a third claw collaborates with associated spiny, elastic hairs to detach the leg from a sticky web strand. This third claw grasps the strand, pulls it against the elastic hairs, and pulls them further, cocking the mechanism. When the claw relaxes, the hairs rebound vigorously, throwing the strand away and springing the leg free.

Police, the military, physicians, and other groups are eager to obtain large quantities of dragline silk, which can be woven or compacted to make bulletproof clothing, replacement ligaments, medical sutures, fishing line, ropes for rock climbers, tethers to snag planes landing on aircraft carriers and myriad other products. It is impracticable to harvest sufficient quantities of silk from spiders due to their territorial nature, so biotechnologists have turned to other sources. The Canadian company Nexia has demonstrated that goats and cows can be genetically engineered so as to produce dragline silk in their milk. Using a clone of such goats, Nexia aims to produce a modified dragline silk, which they call BioSteel, to meet the many demands.

Questions 27 - 29

Write ***no more than three words*** *for each answer.*

27. Which organ of spiders produces silk?

………………………………

28. What kind of silk helps spiders to escape from danger?

………………………………

29. Name three features of dragline silk mentioned by the writer.

………………………………

Questions 30 - 32

Write ***no more than three words*** *for each answer.*

Name three types of regions of proteins constituting dragline silk.

30. ………………………………
31. ………………………………
32. ………………………………

Questions 33 - 37

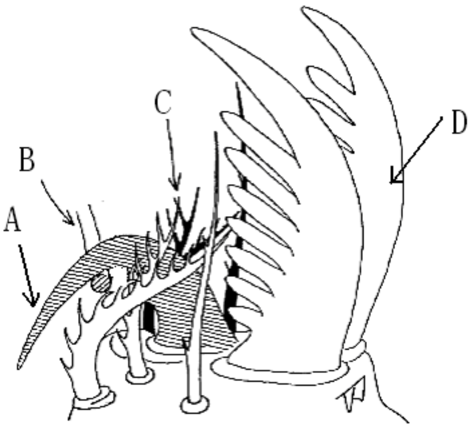
Do the following statements agree with the information given in Reading Passage 3? In boxes 33 – 37 on your answer sheet write.

TRUE	*if the statement is true*
FALSE	*if the statement is false*
NOT GIVEN	*if the information is not given in the passage*

33. The spider discharges an oil to avoid sticking on its own web.
34. The spider use only non-sticky strands when moving on the web.
35. Bridgeline silk belongs to non-sticky strands.
36. BioSteel is a biotechnological name for spiders' dragline silk.
37. According to the writer, the silk Spider-Man used in the movie is less strong than the real dragline silk.

Questions 38 - 40

Complete the diagram below based on ***the third explanation*** *in Reading Passage 3. Write* ***no more than three words*** *for each answer.*



Example B: *the strand*

38. A: ………………………………

39. C: ………………………………

40. D: ………………………………