

1. The layers of the skin are the epidermis (outer layer) and the dermis (inner layer). The epidermis comprises the *cornified*, *granular* and *Malpighian* layers (from the surface of the skin and inwards). Cells in the epidermis produce **melanin** (the pigment that gives the skin its colour) and **keratin** (a fibrous protein that makes the outer layer of the epidermis tough, flexible and water proof). The **dermis** contains hair follicles, sebaceous glands, sweat glands, sensory nerve endings and blood capillaries. Hair follicles and sweat glands originate from the dermis. Sweat ducts and hairs open to the top of the skin cutting across the epidermis. Thus, hair and sweat ducts are found in both layers.

A

2. B

3. B: Cockroaches are known to spread the causative organisms for diarrhoea, dysentery, hepatitis, typhoid fever, leprosy, dermatitis and swelling of the eye lids.

4. D: The adrenal glands are made up of two parts; an inner **medulla** and an outer **cortex**.

**Adrenal medulla** produces: - Adrenaline and Noradrenaline

**Adrenal cortex** produces: - Glucocorticoids e.g. cortisol,

- Mineralocorticoids e.g. aldosterone

- Sex hormones i.e. androgens and oestrogens

N.B:

1. Hormones are secreted into the bloodstream and carried to distant sites where they produce their biological effects.
2. The G-cells of the stomach and duodenum produce gastrin, a potent hormone that plays a role in gastric acid production.
3. The sex hormones (produced from the ovaries and testes) and all the hormones of the adrenal cortex are steroid hormones.

This answer chosen is the most appropriate. However, note that the **G-cells of the stomach** (gastrum) secrete **gastrin**, a hormone that also circulates in blood and promotes stomach hydrochloric acid (HCl) production.

5. A

6. **Abiotic factors** are "non-living" factors and include temperature, rainfall, light, humidity, hydrogen ion concentration, wind, pressure and for aquatic habitats - turbidity, salinity, density, currents, dissolved gases, nature of the substratum etc.

**Precipitation** refers to the nature of rainfall in a locality (an abiotic factor).

Grazing, predation and migration are all factors produced by the activities of living organisms.

7. B: **Acetabulum** is found on the pelvic bone. The **patella** is the sesamoid bone that covers the knee (i.e. knee cap) the **olecranon** fossa is found on the ulna bone.

8. **Alkaloids** include caffeine, nicotine cocaine, morphine, quinine, ephedrine.  
Cinnamon refers to a species of a tree. The name is also used for the commercial spices obtained from that tree.
9. **C:** Chloroplast contains chlorophyll, the green photosynthetic pigment of plants.  
Mitochondria are the power houses of the cell where ATP is produced via aerobic respiration.
10. **B:**  
NB: **Gametogenesis** is the process whereby gametes (sperm cells and oocytes) are produced. The process involves a type of cell division called **meiosis**. Here, the number of chromosome of the parent cell ( $2n$  or diploid) is halved ( $n$  or haploid). In **mitosis** (unlike meiosis), the diploid number of chromosome is unchanged.
11. **B**  
**Sickle cell disease** is inherited in an autosomal recessive manner. **Diabetes** is a disease that results from absolute or relative lack of insulin. **Malaria** is caused by plasmodium species of parasites (*p. falciparum*, *p. malariae*, *p. vivax* and *p. ovale*).
12. **B:** On the other hand, the phenotype is the physical characteristic or manifestations of the genes of an organism.
13. **A:** According to Karl Landsteiner: when a specific antigen is present on the surface of the red blood cells of an individual, the corresponding antibody is absent in the plasma of that individual. Thus is because agglutination only occurs when the same type of **antigen** and **antibody** are present simultaneously; cross-reaction thus occurs.  
An antibody can only react with an antigen against which it was formed and it is specific for. Two antigens do not react, neither does two antibodies.
14. **C:** The definition of "species" is a function of the ability to **inter-breed** freely.
15. **D:** There is a big difference between **phenotypic ratio** and **genotypic ratio** is based on the physical appearance or characteristic of the organism eg.  $RR$  and  $Rr$  will have the same physical appearance (phenotype). each though their genotypes are different thus when  $Rr$  and  $Rr$  are crossed, we obtain  $RR$ ,  $Rr$ ,  $Rr$  and  $rr$ .  
Genotypic ratio- 1: 2:  
Phenotypic ratio – 3:1
16. **B** (see previous year)
17. **D**
18. **D**
19. **D:** Oxygenated blood from the lungs enters the left atrium through the pulmonary veins: the pulmonary arteries carry blood to the lungs, from the right venticle
20. **D**
21.  $P = 2, 4$   
 $Q = 2, 8, 1$   
 $R = 2, 8, 5$   
 $S = 2, 8, 7$   
 $P, Q, R$  and  $S$  belong to groups IV, I, V, VII respectively.  
 $Q$  will form an electrovalent (ionic) bond with  $S$ .  
 $R$  will form a covalent bond with  $S$ .  
 $Q$  will form an electrovalent (ionic) bond with  $R$ .
22. If the oxide contains 30.4% of Nitrogen,  $\Rightarrow$  Oxygen =  $100 - N$   
 $= 100 - 30.4 = 69.6\%$

B

N	O
30.4	69.6
Divide by the mass number:	
$\frac{30.4}{14}$	$\frac{69.6}{16}$
= 2.17	4.35

Divide by smaller number:

$\frac{2.17}{2.17}$	$\frac{4.35}{2.17}$
= 1	2

The Empirical Formula is thus NO<sub>2</sub>

C

Since calculators are not allowed in the exam, you must learn to work without them and approximate appropriately. This skill can only come with constant practice.

23. For questions like this, use the relationship:

$$\frac{\% \text{ of } A}{100} \times \text{mass of } A + \frac{\% \text{ of } B}{100} \times \text{mass of } B = \text{Average atomic mass} \dots\dots\dots(i)$$

However, if the occurrence of the isotopes is expressed in fractions then the above expression becomes:  
*Fraction of A*  $\times$  *mass of A* + *Fraction of B*  $\times$  *mass of B* = *Average atomic mass*

Let A = <sup>35</sup>Cl = A and <sup>37</sup>Cl = B (using equation (i) above) and percentage of A = x.

$$\begin{aligned} \frac{x}{100} \times 35 + \frac{100-x}{100} \times 37 &= 35.5 \\ \frac{35x}{100} + \frac{3700-37x}{100} &= 35.5 \\ 0.35x + 37 - 0.37x &= 35.5 \\ 0.35x - 0.37x &= 35.5 - 37 \\ -0.02x &= -1.5 \\ x &= \frac{-1.5}{-0.02} = 75\% \end{aligned}$$

The percentage of <sup>35</sup>Cl (Isotope A) = 75%. This implies that <sup>37</sup>Cl is 100 - 75 = 25%.

NB: Without even solving, we know that Cl exists in form of two isotopes, <sup>35</sup>Cl and <sup>37</sup>Cl each having a natural abundance of 75% and 25% respectively.

Alternatively:

Let: Average mass - light mass isotope mass be m<sub>1</sub>,  
 Heavy isotope's mass - average mass be m<sub>2</sub> and

$$m_1 + m_2 = m_3$$

$$\text{Then: } m_1 = 35.5 - 35 = 0.5$$

$$m_2 = 37 - 35.5 = 1.5$$

$$m_3 = 0.5 + 1.5 = 2.0$$

$$\% \text{ Heavy Isotope} = \frac{m_1}{m_3} \times 100 = \frac{0.5}{2.0} \times 100 = 25\%$$

$$\% \text{ Lighter Isotope} = \frac{m_2}{m_3} \times 100 = \frac{1.5}{2.0} \times 100 = 75\%$$

24. A: Alkenes undergo addition reactions with halogens, hydrogen, hydrogen halides etc.

NB: Benzene undergoes mainly substitution reactions instead of addition reactions (unlike alkenes). However, it may undergo some addition reaction.



25. C

26. D: magnesium is a powerful reducing agent especially in its powdered form. It can reduce steam ( $\text{H}_2\text{O}$ ),  $\text{SO}_2$ , CO and  $\text{CO}_2$ .

27. This question is based on Pressure Law (Amonton's Law). The Law states that "the pressure of a fixed mass of a gas is directly proportional to its absolute temperature, provided volume is constant"

28. C:  $2\text{Cu}(\text{NO}_3)_{2(s)} \rightarrow 2\text{CuO}_{(s)} + 4\text{NO}_{2(g)} + \text{O}_{2(g)}$  C  
Black

29. A

Alkenes and alkynes commonly undergo addition reactions. This is because they are unsaturated, unlike the alkanes which do not undergo addition reactions. (see Q.24 above also).

30. Hardness of water is due to the presence of dissolved species such as  $\text{CaSO}_4$ ,  $\text{MgSO}_4$  and  $\text{Ca}(\text{HCO}_3)_2$ . The insoluble precipitates are  $\text{CaCO}_3$ ,  $\text{MgCO}_3$  and  $\text{Ca}(\text{OH})_2$  etc. The insoluble scum is Calcium or Magnesium alkanoate.

No answer

31. A: World Health Organisation (WHO) has its international headquarters in Geneva, Switzerland.

32. B: as at year 2012(exam year).

33. C: While Nigeria gained independence in 1960, she became a Republic in 1963

34. For a lift descending or accelerating downwards, the balance weight or apparent weight,  $R = m(g - a)$ , and the acceleration of a body/object with constant velocity is zero. Thus,  $a = 0$ .

Therefore,  $R = m(g - 0)$

$R = mg$  hence,  $R = W$

Recall:  $mg = W$  (weight)

Thus the scale reads a weight equal to that of the man.

B

35. According to Hooke's Law,  $F = Ke$ .

This means that force is directly proportional to extension ( $f \propto e$ ). Thus as force increases, extension also increases.

From the question, force  $F$  increases by a factor of 4, i.e.  $20/5 = 4$ . Therefore, extension will also increase by a factor of 4 i.e.  $4 \times 0.56 = 2.24\text{cm}$

B

Alternatively:  $F = Ke$

$$K = \frac{F}{e} = \frac{5}{0.56} = 8.928 \text{ N/m}^2$$

From,  $F = Ke$

$$e = \frac{F}{K} = \frac{20}{8.928} = 2.24 \text{ cm}$$

36. Anomalous = abnormal expansion

Anomalous expansion of water occurs at temperature range of  $-4^\circ\text{C}$  to  $0^\circ\text{C}$ .

D

37. C

38. Volume expansivity coefficient =  $\frac{\text{Increase in Volume}}{\text{Original volume} \times \text{Temp change}}$

i.e. 
$$\gamma = \frac{\text{Increase in Volume}}{V_0 \times \Delta T} \dots\dots\dots (x)$$

NB: Coefficient of Volume Expansivity = 3 × Coefficient of Linear Expansivity

i.e. 
$$\gamma = 3\alpha$$

From equation (a) above: 
$$3\alpha = \frac{\text{Increase in Volume}}{V_0 \times \Delta T}$$

$\therefore$  Increase in volume =  $3\alpha V_0 \Delta T$  i.e. =  $3\alpha VT$

C

39. B: Increasing order implies from lowest to highest.

40. D

Graphite block or heavy water (deuterium oxide) are used to slow down fast moving neutrons whereas Boron rod is used to control rate of neutron production.

NB: Graphite block and deuterium oxide are moderators. Boron rods are control. Molten sodium and carbon dioxide are used as coolant.

41.  $x \propto y$

$x \propto \frac{1}{z} \Rightarrow x \propto \frac{y}{z} \text{ and } x = \frac{Ky}{z}$

(where K is a constant of proportionality).

From:  $x = \frac{Ky}{z}$ , at  $x = 9$ ,  $y = 24$  and  $z = 8$ ,

$9 = \frac{K(24)}{8}, \quad K = \frac{9 \times 8}{24} = 3$

$\therefore x = \frac{3y}{z}$

Thus at  $y = 5$  and  $z = 6$ ,

$x = \frac{3y}{z} = \frac{3 \times 5}{6} = \frac{5}{2} = 2 \frac{1}{2}$

42.  $\sqrt{3x} = \sqrt[3]{9}$

D

$(3x)^{1/2} = (9)^{1/3}$

$3^{1/2} x^{1/2} = 9^{1/3}$

$x^{1/2} = \frac{9^{1/3}}{3^{1/2}} = \frac{(3^2)^{1/3}}{3^{1/2}} = \frac{3^{2/3}}{3^{1/2}}$

$x^{1/2} = 3^{2/3 - 1/2} = 3^{1/6}$

$$x^{1/2} = 3^{1/6}$$

$$\Rightarrow x = \left(3^{1/6}\right)^2 \quad [\text{squaring both sides}]$$

$$x = 3^{1/3}$$

43.

$$\frac{5}{x+1} - \frac{3}{1-x} - \frac{7x-1}{x^2-1}$$

$$\text{LCM} = -x^2 + 1$$

Likely Option: C

$$\frac{5(1-x) - 3(x+1) - (7x-1)}{-x^2+1}$$

$$\frac{5-5x-3x-3-7x+1}{-x^2+1} = \frac{3-15x}{-x^2+1}$$

$$= \frac{3(1-5x)}{-x^2+1} = \frac{3(1-5x)}{(x+1)(1-x)}$$

$$= \frac{3(1-5x)}{1-x} \times \frac{1}{x+1}$$

44.

$$4x - 3 = 3x + y = 2y + 5x - 12$$

Using substitution method:

$$\text{From: } 4x - 3 = 3x + y$$

$$y = 4x - 3 - 3x$$

$$y = x - 3 \dots\dots\dots(i)$$

Substituting this into the other relationship:

$$4x - 3 = 2y + 5x - 12$$

$$4x - 3 = 2(x - 3) + 5x - 12$$

$$4x - 3 = 2x - 6 + 5x - 12$$

$$4x - 3 = 7x - 18$$

$$-3 + 18 = 7x - 4x$$

$$15 = 3x \quad x = 15/3 = 5$$

$$\text{Using: } 4x - 3 = 3x + y$$

$$4(5) - 3 = 3(5) + y$$

$$20 - 3 = 15 + y$$

$$17 = 15 + y \quad y = 17 - 15 = 2$$

$$x = 5 \text{ and } y = 2$$

45.

Since  $x = 1$  is a root of  $x^3 - 2x^2 - 5x + 6$ , it implies that  $(x - 1)$  is a factor of  $x^3 - 2x^2 - 5x + 6$ . The other quadratic factor is gotten by dividing  $x^3 - 2x^2 - 5x + 6$  by  $x - 1$ .

$$\begin{array}{r}
 x^2 - x - 6 \\
 x-1 \overline{) x^3 - 2x^2 - 5x + 6} \\
 \underline{-x^3 - x^2} \phantom{+ 6} \\
 -x^2 - 5x + 6 \\
 \underline{-x^2 + x} \phantom{+ 6} \\
 -6x + 6 \\
 \underline{-6x + 6} \\
 0 \quad 0
 \end{array}$$

Thus the other quadratic factor is  $x^2 - x - 6 = (x-3)(x+2) = 0$ . i.e.  $x-3=0$  and  $x+2=0$ .  
 $\Rightarrow x=3$  and  $x=-2$

C

46.  $x \propto y^3 z^4$

$\Rightarrow x = Ky^3 z^4$

Now at  $\left(\frac{y}{2}\right)^3$  and  $(2z)^4$

$x = K \frac{y^3}{8} 16z^4$

$x = 2Ky^3 z^4$

This implies that  $x$  will increase by a factor of 2 at these new values of  $y$  and  $z$ . Thus it is a 2:1 increase.

B

47. The sum on interior angles of a polygon is  $(n-2)180^\circ$

A hexagon is a 6-sided polygon,  $\Rightarrow n=6$

$\therefore$  Sum of interior angles of a hexagon is  $(6-2)180^\circ = 4 \times 180 = 720^\circ$

If one of the interior angles =  $170^\circ$ , then the remaining 5 angles =  $720 - 170^\circ = 550^\circ$

If each of the 5 angles =  $x$ , then  $5x = 550^\circ$

$x = \frac{550^\circ}{5} = 110^\circ$

B

48.  $-2 \leq 2x - 6 < 4$

$\Rightarrow \begin{array}{ll} 2x - 6 \geq -2 & \text{and} \quad 2x - 6 < 4 \\ 2x \geq 4 & \text{and} \quad 2x < 10 \\ x \geq 2 & \text{and} \quad x < 5 \end{array}$

$\therefore$  The integers that satisfies the inequalities are 2, 3, 4.

B

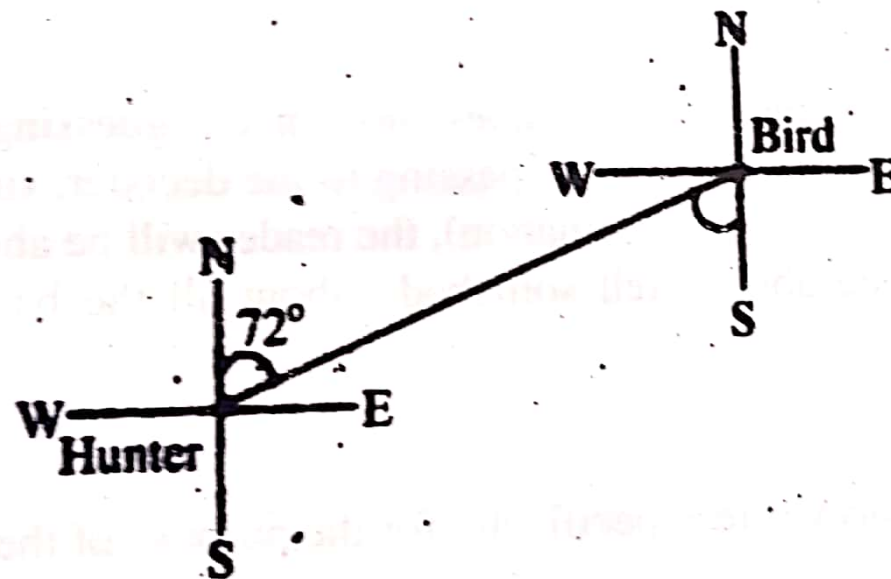
49. R is the square of half the coefficient of  $x$ .

$= \left(-\frac{7}{2}\right)^2 = \frac{49}{4}$

A

To make a Quadratic expression a perfect square, add the square of half the coefficient of  $x$  to the expression.

50. This kind of questions are best represented with a diagram.



The bearing of the hunter from the tree is  $S72^\circ W$