1. A) Colour blindness is a sex-linked characteristic.

The gene for colour vision is on the X chromosome

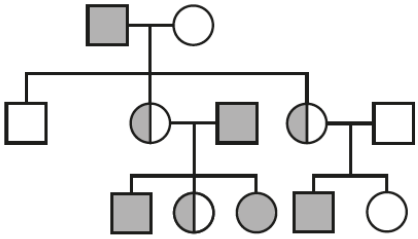
.

There are two alleles of this gene:

- **B** is the allele for normal colour vision

- **b** is the allele for colour blindness.

Fig. is a pedigree chart showing the inheritance of colour blindness in a family. The key shows the sex chromosomes and the alleles of the gene for colour vision.



**Key**

| | |
|---|---|
| male with normal colour vision | $X^BY$ |
| colour-blind male | $X^bY$ |
| female with normal colour vision | $X^BX^B$ |
| carrier female with normal colour vision | $X^BX^b$ |
| colour-blind female | $X^bX^b$ |

Describe evidence from Fig. 3.2 that shows that colour blindness is a sex-linked characteristic.

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B) A man with normal color vision ($X_BY$) and a woman who is colour-blind ($X_bX_b$) have a baby. Complete the genetic diagram to predict the probability that the baby is colour-blind.

| | | | |
|---|---|---|---|
| *parental phenotypes* | male with normal colour vision | x | colour-blind female |
| *parental genotypes* | $X^BY$ | x | $X^bX^b$ |
| *parental gametes* | ..... ..... ..... ..... | | |

*offspring genotypes* ..... ..... ..... .....

*offspring phenotypes* ..... ..... ..... .....

probability that the baby is colour-blind:

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2) A gene is involved in the production of the enzyme alcohol dehydrogenase.

**(i)** Define the term *gene*.

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**(ii)** Describe the role of ribosomes in the synthesis of proteins such as enzymes.

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3A) The genes for antibodies are only active in lymphocytes.

**(a)** Define the term *gene*.

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4A) Many researchers are studying the structure and function of genes.

**(a)** Define the term *gene*.

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B) Every living cell is able to make proteins.

The process begins in the nucleus.

Describe how proteins are made in a cell.

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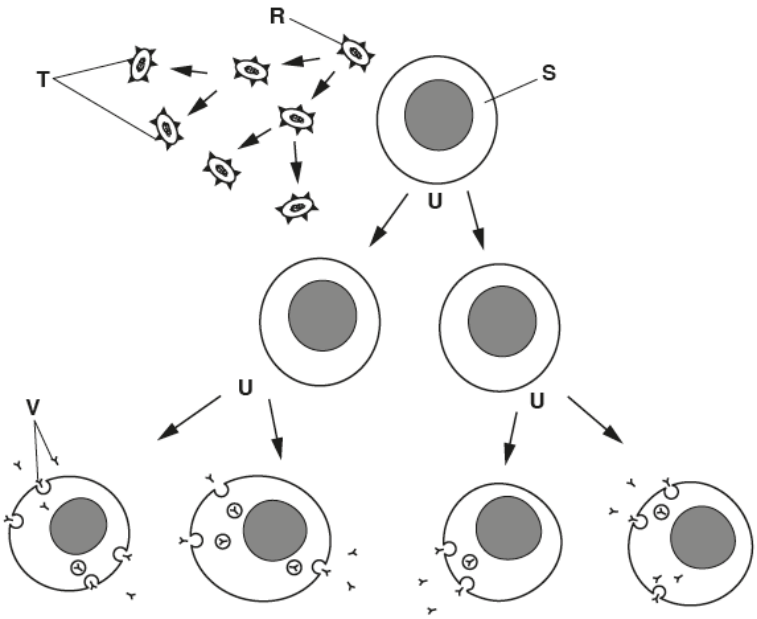
Fig. 6.1 is a flow diagram that shows what happens at the start of a bacterial infection.



5A) Cell **R** is a prokaryote and cell **S** is a lymphocyte.

**(i)** State the names of **two** cellular structures that would be found in **both** prokaryotes and white blood cells.

1 .....

2 .....

B)

Cell **R** is a pathogen that has structures **T** on its surface. These structures are recognized by cell **S**. Cell **S**is a lymphocyte and it produces structures **V**. Cell **R** reproduce by binary fission and cell **S** divides by process **U**.

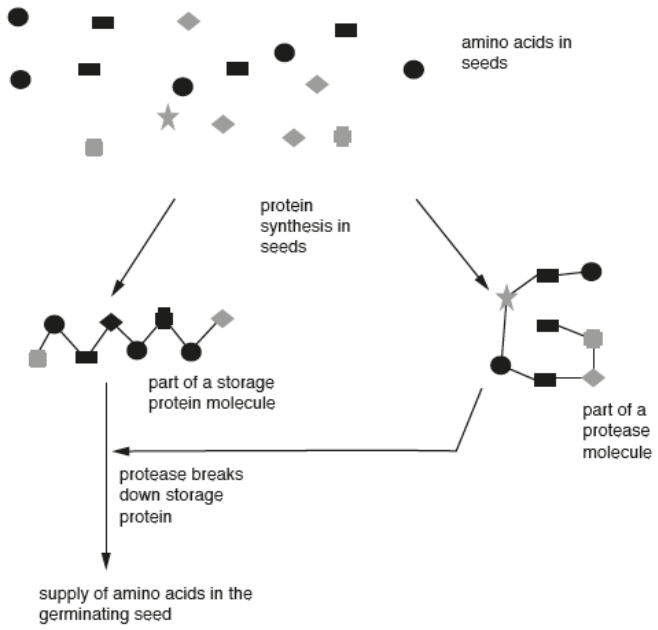
Identify **T** to **V** from the passage and Fig. 6.1.

**T** .....

**U** .....

**V** .....

6A) During seed development, amino acids are converted into storage proteins and proteases. Protease molecules become active when the seed absorbs water at the start of germination. Fig. 2.1 shows the formation of a storage protein and a protease in developing quinoa seeds and the action of protease on the storage protein during germination.



**(i)** During seed development in quinoa some genes are ‘switched on’.

Define the term *gene*.

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**(ii)** Describe the differences in structure between the storage protein and the protease shown in Fig.

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B) State the roles of mRNA and ribosomes in protein synthesis.

mRNA .....

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ribosome .....

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7) Stem cells are also found under the outer layer of the skin.

Explain why stem cells are found in the skin.

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8) Following fertilisation, seeds will form.

In pea plants there are two alleles for height:

- tall (**T**)
- dwarf (**t**)

**(i)** Define the term *allele*.

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**(ii)** A farmer wanted to identify the genotype of tall pea plants as either homozygous dominant or heterozygous

He used a homozygous recessive dwarf pea plant to determine the genotype of the tall pea plants.

State the name of this type of genetic cross.

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**(iii)** Complete the genetic diagram to determine the genotype of the parent plant if all the offspring from the cross are tall plants.

| | | | |
|---|---|---|---|
| *parental phenotypes* | tall | × | dwarf |
| *parental genotypes* | ..... | × | ..... |
| *gametes* | ..... ..... | + | ..... ..... |

*offspring genotype* .....

*offspring phenotype* .....

**(iv)** Another farmer wants to produce pure-breeding dwarf pea plants.

State the genotypes of both of the parent pea plants the farmer should use.

Give a reason for your choice.

genotypes .....

reason .....

.....

**9A) Gregor** Mendel studied inheritance in the garden pea, *P. sativum*.

The flowers of *P. sativum* that he studied were either purple or white. The gene that controls flower colour has two alleles, **B** and **b**.

When Mendel crossed purple-flowered plants with white-flowered plants all the plants in the next generation had purple flowers.

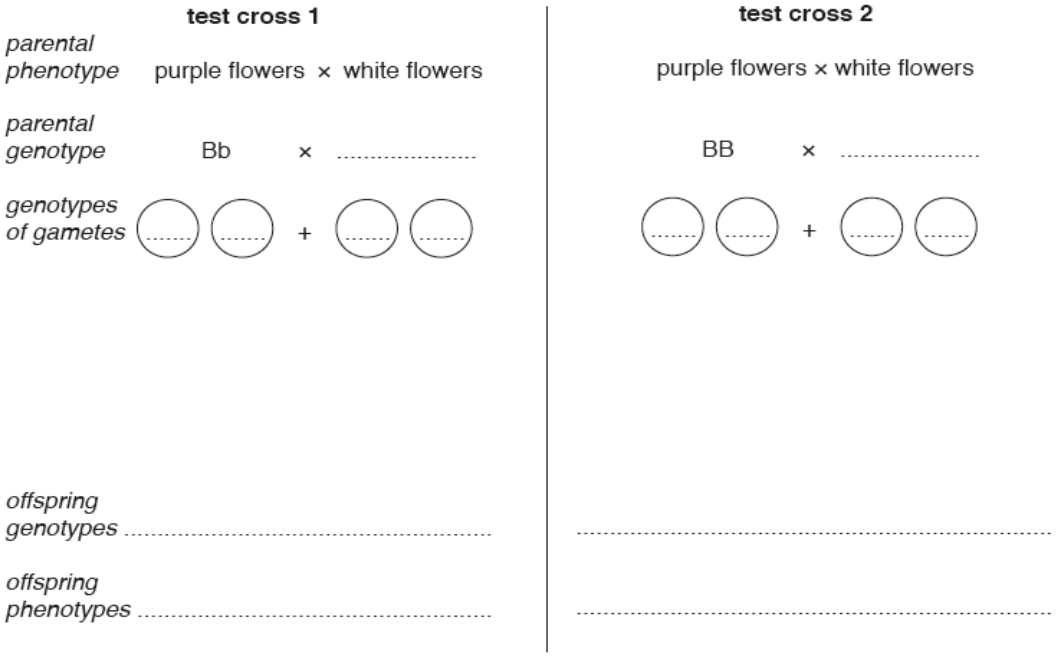
**(i)** Table 4.1 shows five genetic terms that can be applied to Mendel's study of the inheritance of flower colour.

Complete Table 4.1 by stating an example of each genetic term. The first one has been completed for you.

| term | example in *P. sativum* |
|---|---|
| dominant trait | purple flowers |
| recessive allele | |
| phenotype | |
| homozygous genotype | |
| heterozygous genotype | |

Test crosses can be used to determine the genotype of a plant with purple flowers.

The genetic diagrams show test crosses for purple-flowered plants with two different genotypes. Complete the genetic diagrams for test cross 1 and test cross 2.



B) Pickerel weed, *Pontederia cordata*, is a plant that grows in shallow water on the edges of ponds and lakes in North America.

A few seedlings of these plants are white. The white seedlings cannot make chlorophyll.

Researchers carried out several crosses using pickerel weed plants.

Their results are shown in Table 4.2.

| cross | number of offspring | |
|---|---|---|
| | green | white |
| 1 | 149 | 0 |
| 2 | 70 | 22 |

**(i)** Select suitable symbols for the alleles and state the possible genotypes of the parents for each cross.

cross 1 .....

cross 2 .....

**(ii)** It is **not** possible to carry out a test cross with pickerel weed plants. Suggest why.

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10A.I) DNA controls cell function by controlling the production of proteins.

**(i)** Proteins are coded for by a length of DNA.

What is the name given to the length of DNA which codes for a protein?

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**(ii)** Describe the role of mRNA in protein synthesis.

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11A) Catalase is an enzyme that breaks down hydrogen peroxide inside cells. Red blood cells contain catalase.

Some dogs have an inherited condition in which catalase is not produced. This condition is known as acatalasia and it is caused by a mutation in the gene for catalase.

**(a)** Define the terms *gene* and *gene mutation*.

gene.....

.....

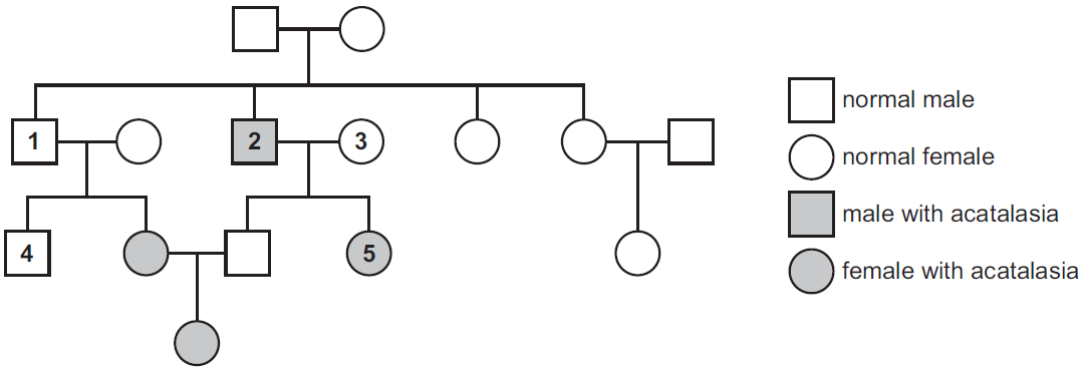
gene mutation.....

.....

B) A geneticist was asked to investigate the inheritance of acatalasia in dogs.

The normal allele is represented by **B** and the mutant allele is represented by **b**.

The geneticist made the diagram in Fig. 3.1 to show the inheritance of acatalasia in a family of dogs. The shaded symbols indicate the dogs with acatalasia.




**(i)** State the genotypes of the dogs identified as **1**, **2** and **3** in Fig. 3.1.

**1** .....

**2** .....

**3** .....

II) The geneticist crossed dog **4** with dog **5**. Approximately half of the offspring had acatalasia and half the offspring did not have acatalasia.

Complete the genetic diagram to show how this is possible.

| | dog **4** | dog **5** |
|---|---|---|
| *parental phenotypes* | normal | has acatalasia |
| *parental genotypes* | ..... | ..... |
| *gametes* | ..... , ..... | + ..... |
| *Punnett square* | | |

*Offspringgenotypes*.....

*offspring phenotypes*.....

**(iii)** State the name given to the type of cross that you have completed in **(b)(ii)**.

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12A) Meiosis is necessary for sexual reproduction of carnation plants.

Define the term *meiosis*.

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B) Carnation plants show co-dominance for the anthocyanin gene. There are two alleles:

- $F^A$ – allele for anthocyanin pigment (red flowers)
- $F^N$ – allele for no anthocyanin pigment (white flowers)

**(i)** State the genotype of a carnation plant that is heterozygous for this gene.

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**(ii)** Describe the phenotype of a heterozygous carnation plant for this gene.

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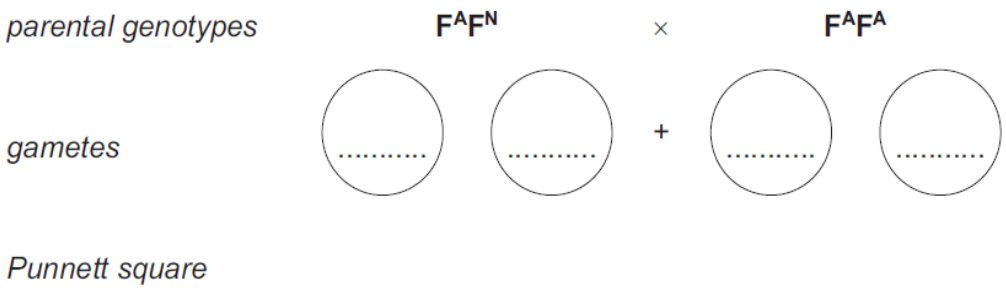
(III) The breeder crossed a $F^A F^N$ carnation plant with a $F^A F^A$ carnation plant. Predict, using a genetic diagram, the proportion of pure breeding carnation plants in the offspring.




*offspring genotypes* .....

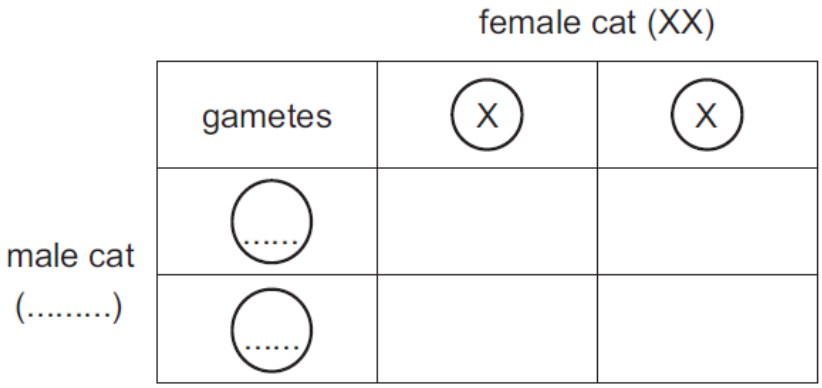
*offspring phenotypes* .....

proportion of *pure breeding* carnation plants .....

13a) Sex in cats is determined in the same way as in humans.

Complete the diagram below to show how sex is determined in cats.

male cat female cat




offspring ratio.....

b) A scientist investigated the inheritance of fur colour in cats.

The gene for coat colour is located on the X chromosome. The gene has two alleles:

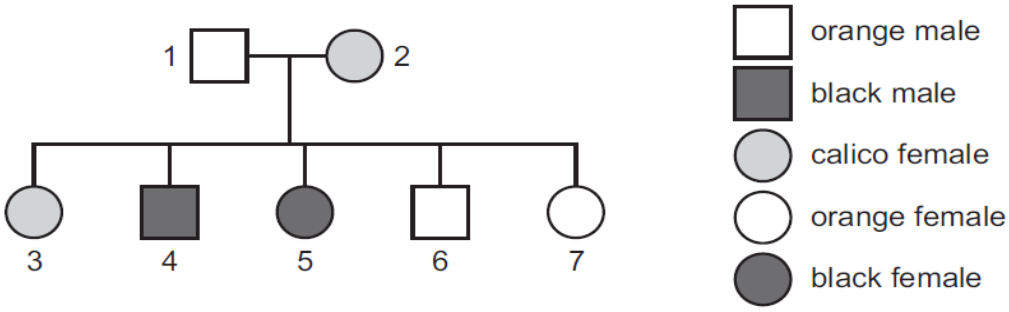
- **B** black
- **b** orange

The X chromosome with the allele for black is represented by $X^B$.

The X chromosome with the allele for orange is $X^b$..

A female cat can be a mixture of these colours, described as calico.

Fig. 3.1 shows the inheritance of this condition in a family of cats.




**(i)** State the genotypes of cats 1, 4, and 5 in Fig.

cat 1 .....

cat 4 .....

cat 5 .....

**(ii)** Coat colour in cats is an example of discontinuous variation.

Explain why coat colour is an example of discontinuous variation.

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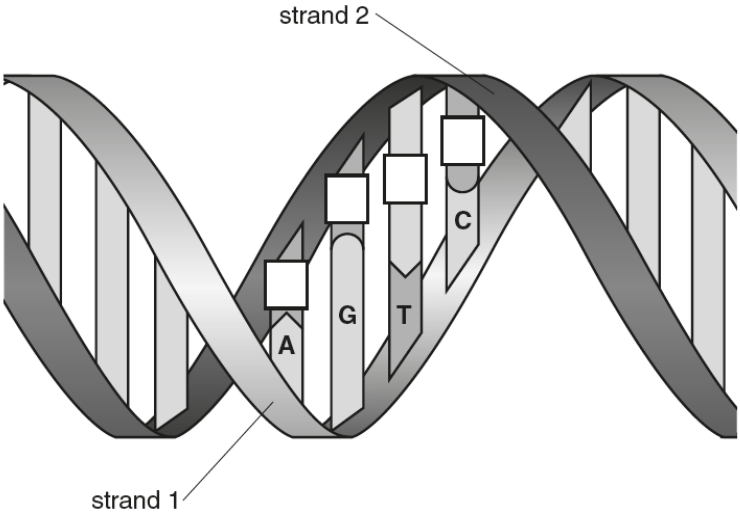
14) A DNA molecule has two strands as shown in Fig. 6.1.



**(a) (i)** Fill in the boxes on Fig. 6.1 to show the letter of the bases on strand 2 that will pair with the corresponding bases on strand 1.

**(ii)** State the name for the structure of a DNA molecule as shown in Fig.

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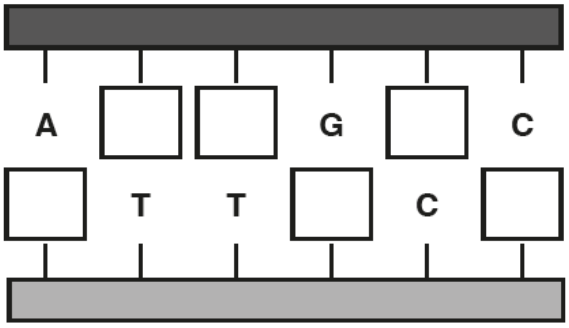
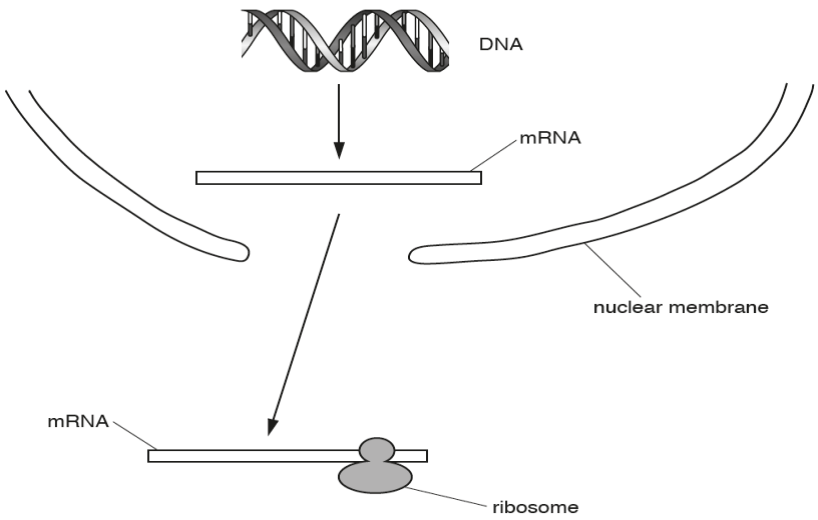
15a) Fig. is a diagram showing a small region of DNA.

Fig. shows part of the DNA enlarged to show the sequence of bases.




Complete Fig. by adding the letters for the bases that are missing.

b) Fig shows how DNA is involved in protein synthesis.



Explain how mRNA is involved in protein synthesis.

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16 **(i)** Describe the structure of a DNA molecule.

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**(ii)** State the function of a gene.

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