A level Biology A

H420/03 Unified biology

Question Set 3

1 Tigers, *Panthera tigris*, are predatory mammals. They have evolved striped patterns on their fur,as shown in Fig. 3.1a, which provide camouflage in their habitats.

Fig. 3.1a

(a) (i) Adaptations can be divided into three types.

State the type of adaptation represented by the tiger's stripes. **[1]**

anatomical

(ii)* Describe and explain how a tiger with striped fur may have evolved from a non-striped ancestor.

In your answer you should discuss the different types of genes that might be involved in the creation of the striped pattern in the tiger's fur. **[6]**

Natural Selection

- mutations of pigment gene and regulatory gene
- selection pressure of prey availability
- adaptation helped tigers camouflage
- striped tigers had a greater survival probability and were more likely to reproduce
- beneficial alleles passed onto next generation
- allele frequency for relevant genes increase with each generation
- after many generations, all tigers within a population were striped

Role Of Regulatory Genes

- regulatory genes control the pattern / where pigments produced or expression of genes
- genes switched on or off during development (epigenetic changes)
- recessive epistasis prevents expression of pigment gene

(b) One subspecies of tiger is the Bengal tiger. One in 10 000 Bengal tiger births results in a white Bengal tiger.

White Bengal tigers, as shown in Fig. 3.1b, have black stripes but lack orange fur.

Fig 3.1b

The allele that causes white fur is recessive and is a result of a mutation to a gene called SLC45A2.

According to the Hardy-Weinberg principle, the following equations can be used to estimate allele frequency within a population:

$$p^2 + 2pq + q^2 = 1$$

$$p + q = 1$$

Use the Hardy-Weinberg equations to calculate the percentage of Bengal tigers that are heterozygous for the SLC45A2 gene.

Give your answer to **one** significant figure.

Show your working.

$p = 1 - 0.01 = 0.99$

$q^2 = 0.0001 \quad q = 0.01$

$2pq = 2 \times 0.99 \times 0.01 = 0.0198 \simeq 0.02 = 2\%$

Answer: 2 % **[3]**

Total Mark for Questions Set 3: 10