Ladybird exam correction (tricky parts are in bold)

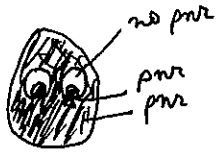
1. Yes it is possible that a single locus is involved in the colour pattern difference:
a/a x b/b -> F1: a/b → F2: 25% a/a, 50% a/b, 25% b/b (1 pt)
'semi-dominance" or "co-dominance" (1 pt). [Note: actually, the correct term for this particular phenomenon is "spatial dominance"]

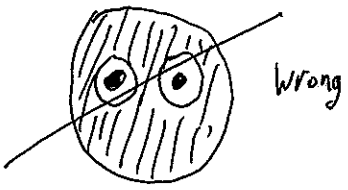
2. two possibile explanations:
(1) the causal locus is a regulatory region of another gene located away from the QTL region.
(2) the gene is within the QTL but it has not been annotated (microRNA gene for example).
(1pt if one explanation is mentionned)

3. EFGP = negative control = to make sure that RNAi procedure itself has no effect on coloration. (1 pt)
Two non-overlapping regions of pnr were targeted to **control for off-target effects**: if one RNAi gives a pigmentation phenotype, it is still possible that this aberrant phenotype is due to the inactivation of another gene than pnr. When the same mutant phenotype is observed with two different RNAi tragetting the same gene, it confirms that the effect is not due to an off-target effect of the RNAi. (1 pt)
pnr is required for production of black pigments and GATA is not [or less than pnr]. (1 pt)

4. sense = negative control = to make sure that the in situ staining procedure itself does not give a specific coloration pattern. (1 pt)
The antisense coloration shows that pnr is expressed in the elytra regions that will produce black pigments. (1 pt)

5.





6. scheme in two parts:
black region: expression of pnr → action on gene expression → production of melanin
red region: no expression of pnr → production of carotenoids
[note that melanin and carotenoids are not proteins. They are produced from tyrosine (for melanin) and from fats and other basic organic metabolic building blocks (for carotenoids) via enzymes]

7. inversion/inverted region

8. The coloration pattern changes with temperature. (0.5 pt)
There is **increased variability in spot number at increasing temperature** (0.5 pt)
This phenomenon is called plasticity. (1 pt)

9. **Remove elytra and see if they can fly** (when you push them with a brush for example). Positive control = with elytra

10. **use black/red paint on elytra to test various coloration patterns** (1 pt)
put 2 males and one virgin female together in a chamber and video record their interactions (mate choice assay) . Both males can be painted, to make sure that the paint itself does not create the difference).

11. **perform association mapping using the pnr locus as the candidate locus** (1 pt)
[CRISPR is not possible because it is mentioned that these organisms cannot be raised in the lab]

12. 32 (1pt)

13. - disrupt coding region → loss of function
- disrupt cis-regulatory region → disrupt gene expression levels/pattern
- 2 TE → inversion and disruption of several genes at once
- disrupt splicing
etc.