

**BRITISH BEEKEEPERS' ASSOCIATION**  
**MODULE 6 HONEY BEE BEHAVIOUR**  
**Sample Paper Marking Scheme**

- Marks should only be awarded for points which answer the question.
- The allocation of points to be included are a guide to what should be included and are not necessarily definitive.
- Where more points are provided than the number requested eg 8 points when only 6 are asked for, then first 6 answers should be taken.
- 0 marks if answer doesn't work
- Do not penalise poor spelling so long as the meaning is clear other than technical terms.
- **How the answer is phrased is not important but that aspect must be understood from the answer rather than just mentioning the words.**

**SECTION A (10 marks, 1 for each question)**

- Q1 What term is used for the mechanism of controlling the environment within the hive?  
A Homeostasis
- Q2 When are drones absent in the colony?  
A Autumn and Winter / September to March
- Q3 Name one method of communication within the hive.  
A Trophylaxis / pheromones / dancing / scenting
- Q4 Name one plant from which bees collect propolis.  
A Horse chestnut / Alder / Poplar
- Q5 What is the average weight of pollen load carried by a honeybee?  
A  $8\text{mg} \times 2 / 16\text{mg}$
- Q6 What occurs at a drone congregation area?  
A Mating of queens
- Q7 What is the term given to the removal of eggs laid by worker bees?  
A Worker policing
- Q8 At what stage in the life of a worker bee does it normally take on the task of foraging?  
A At around three weeks after emergence
- Q9 Name one factor which stimulates a queen to increase her laying rate.  
A Increased day length / increased income
- Q10 Give one use of water within the hive.  
A Cooling the colony through evaporation/ production of brood food/ dilution of honey stores in winter.

## Section B

- Q11 (a) Other than bees from a different colony, name four other intruders found in the UK which may attempt to enter a beehive? 4
- (b) How will these be dealt with if they enter the hive? 2
- (c) Describe the difference between drifting and robbing bees. 4
- (d) How will the colony react to robbing bees? 5

**Q11 (a) Other than bees from a different colony, name four other intruders found in the UK which may attempt to enter a beehive? 4 Marks**

1. Wasps, bumble bees, hornets
2. ants,
3. mice,
4. earwigs
5. slugs,
6. wax moth.

*1 Mark for each maximum*

**(b) How will these be dealt with if they enter the hive? 2 Marks**

1. Attacked by the guard bees and ejected
2. or if too large stung and embalmed in propolis.

*1 Mark for each*

**(c) Describe the difference between drifting and robbing bees. 4 Marks**

Robbing

1. zig-zag flight pattern across the entrance.

Drifting

2. enters confidently with load of nectar and/or pollen,
3. becomes submissive when inspected by the guard bee
4. curling her legs and tucking in the abdomen,
5. may release a sample of nectar. stop

*1 Mark for each maximum 4*

**(d) How will the colony react to robbing bees? 5 Marks**

1. Guard bee raises into guard position with front legs raised, mandibles open and wings spread out
2. the guard bee releases alarm pheromone 2-heptanone from the mandibular glands.
3. If the intruder does not go away, then the guard bee will try to nibble its wings and then sting it by clamping on to a leg or wing and curling its abdomen around.
4. The stinging releases the alarm pheromone isopentyl acetate
5. which recruits additional guard bees to help.

*1 Mark for each maximum 5*

- Q12 (a) List the duties that a worker honeybee undertakes between her emergence in April until her death and the average ages these duties occur? 7
- (b) How do these duties differ for a worker honeybee emerging in October until her death? 8

**(a) List the duties that a worker honeybee undertakes between her emergence in April until her death and the average ages these duties occur? 7 Marks**

In an ideal situation the sequence of jobs in roughly chronological order is:

1. (~1-3 days) Cleaning cells– gorge on pollen
2. (~3-15 day) Brood rearing and queen tending
3. (~16-20 days) receiving and packing nectar/pollen
4. (~10-18 days) Comb-building– wax glands developed
5. Ventilation/homeostasis control
6. (~12-25) guarding
7. Foraging

*1 mark per line max 7*

**b) How does this differ for a worker honeybee emerging in October until her death? 8 Marks**

1. Worker bees emerging in Oct will have very little or no brood to rear and no comb to build.
2. Have large amounts protein in their fat bodies due to consumption of pollen that isn't used to produce brood food or wax (life of bee is directly proportional to amount of pollen consumed).
3. Need to survive until following spring so they can feed new brood in spring ~24weeks.
4. Cluster tightens when ambient temp drops below 14°C to maintain internal temp of cluster ~20-30°C (provided no brood present).
5. Vibrate wing muscles to keep temperature constant.
6. Dilute honey with water from condensation or collected on mild days, not usually able to forage outdoors
7. Uncapping honey to allow hygroscopic absorption of water
8. After ~Dec 21st (shortest day) queen starts laying and winter bees use their stored protein to feed brood.
9. Break in weather 10°C+ take cleansing flights.
10. Early spring on warm days forage mainly for pollen to feed brood with.
11. Start dying off early March – danger time for colony as brood exceeds adult bees.

*1 mark for each point to a max of 8*

- Q13 (a) How does a bee learn to recognise the position of its hive? 8
- (b) What is the term given to this type of learning? 1
- (c) A worker honeybee has been given the direction and distance to a new forage source by observing a dancing bee. List the navigational methods used for determining direction and distance during the first flight of a new recruit to find the new forage source. (You do not need to describe any dances) 6

**Q13 (a) How does a bee learn to recognise the position of its hive? 8 Marks**

1. Orientation flights from around one-week old in front of the hive and immediate vicinity
  2. learns appearance of hive and landmarks nearby.
  3. young bees from a colony usually take their first flights about mid-day.
  4. flights short duration and end abruptly.
  5. Use of the position of the sun (using a biological clock)
  6. Odour – hive and surroundings
  7. Colour – hive,
  8. Shape – hive and landscape
- 1 mark per line to a maximum of 8*

**(b) What is the term given to this type of learning? 1 Mark**

1. Latent or observatory.

**(c) A worker honeybee has been given the direction and distance to a new forage source by observing a dancing bee. List the navigational methods used for determining direction and distance during the first flight of a new recruit to find the new forage source. (You do not need to describe any dances) 6 Marks**

1. primary navigation tool is the sun.
  2. able to compensate for the sun's movement with passing time.
  3. Use polarized light if sun not visible
  4. need at least 10% of blue sky for accurate use of polarized light
  5. aware of magnetic fields.
  6. calculated by amount of energy expended (von Frisch)
  7. or using optic flow speed and time, (how quickly image of environment moves across their eyes).
- *1 mark for each point to a max of 6*

- Q14 (a) What are the factors that will initiate the building of new comb? 5  
(b) What are the factors that allow for efficient use of comb? 5  
(c) What is propolis used for within the colony? 5

**Q14. (a) What are the factors that are required for the building of new comb? 5 Marks**

1. Pollen available to activate wax glands
2. Large quantities of incoming nectar/syrup
3. hive temperature of 35 degrees C
4. brood and stores filling the available space – need more space,
5. laying queen.
6. Bees of the correct age 12+ days

*1 mark per line to a maximum of 5*

**(b) What are the factors that allow for efficient use of comb? 5 Marks**

1. Combs must hang vertically,
2. combs must be parallel to each other,
3. there must be the correct bee space between each comb,
4. the cells need to be the correct size i.e. worker or drone.
5. hexagonal shape efficient
6. Angle of cell retains contents
7. Cells offset on each side for strength

*1 mark per line to maximum of 5*

**(c) What is propolis used for within the colony? 5 Marks**

1. Fills small cracks keeping out draughts and rain,
2. used to varnish the inside of a natural cavity,
3. used as an antiseptic when used to varnish brood cells prior to the queen laying in them,
4. used to reduce entrances in order to protect against intruders and bad weather,
5. strengthens comb,
6. intruders which are too large to remove are propolised to prevent decay polluting the nest.

*1 mark per line to maximum of 5*

- Q15 (a) What are the triggers for a colony to start preparations for swarming? 5  
(b) Explain briefly the behaviour of a colony of honeybees from the construction of swarm cells to the emergence of the first virgin queen. 10

**Q15 (a) What are the triggers for a colony to start preparations for swarming? 5 Marks**

1. Lack of pheromones – QMP & QTP,
  2. hereditary factors,
  3. age and condition of the queen,
  4. average age of workers, swarming more likely when the average age is low,
  5. external conditions – good nectar flow and supply of pollen,
  6. rain may also make the colony more congested as the foragers cannot get out.
- 1 mark per line to a maximum of 5*

**(b) Explain briefly the behaviour of a colony of honeybees from the construction of swarm cells to the emergence of the first virgin queen. 10 Marks**

1. Larvae in QCs are fed royal jelly for five days before being capped.
  2. Foragers become scouts and investigate new nest sites.
  3. Workers reduce the food fed to the queen in order to reduce her weight so that she can fly, this also reduces her egg-laying rate.
  4. The queen is kept moving by workers performing the dorso-ventral abdominal vibration dance on her and biting her legs.
  5. The workers load up with honey ready to swarm
  6. Buzzing runs to prepare to swarm
  7. The prime swarm leaves when the first cell is sealed.
  8. Workers keep the queen cells warm
  9. Workers nibble round the end of the cell to thin
  10. Other virgins are kept within cells
  11. Virgin queen emerges and pipes
- 1 mark per line to a maximum of 10*

### Section C

- Q16 (a) A honeybee has landed on a flower. Describe how nectar is collected and transported back to the hive. Include changes that may happen to the nectar. 9
- (b) What happens on her return to the hive with a full load of nectar up to the point the honey cell is sealed? 18
- (c) Briefly describe the colony prepares the honey for consumption over winter. 3

**Q16 (a) A honeybee has landed on a flower. Describe how the nectar is collected and transported back to the hive. Include changes that may happen to the nectar. 9 Marks**

1. Her proboscis is inserted into the corolla of the flower
2. and the cibarium is expanded drawing nectar into her mouth.
3. Enzymes are added to the nectar from the hypopharyngeal
4. Glucose oxidase, diastase, and sucrose
5. The nectar passes through the oesophagus to the crop (or honey stomach)
6. Pollen is filtered out by the proventriculus
7. which allows a proportion of the nectar to provide fuel for the return flight
8. it is stored in the crop by the forager until she returns to the hive.
9. It takes 30-80 minutes to collect a load of an average of 40 mg.

*1 mark per line to a maximum of 9*

**(b) What happens on her return to the hive with a full load of nectar up to the point the honey cell is sealed? 18 Marks**

1. Guard bees allow into hive onto comb
2. If the source of nectar is good and nectar is required, the bee will dance
3. round, sickle or waggle depending on the distance the forage is away from the hive,
4. she may give a sample of nectar during the dance
5. she may have to wait for house bees to come to unload her nectar depending on the requirements of the colony at the time,
6. she unloads nectar to between 1 and 3 house bees,
7. by exuding a droplet on her proboscis.
8. The bees touch each other's antennae during this process (antennate).
9. Once unloaded the forager cleans antennae and wipes her proboscis through her front feet, before flying-off again.
10. The receiver house bee repeatedly exposes a drop of nectar on its partly folded proboscis
11. and exposes it to air circulating in the hive
12. could take up to 20 minutes
13. Enzymes continue to be added
14. An increase in air flow through fanning bees aid evaporation.
15. The drop of nectar is then place at the top of a cell where it hangs continuing the evaporation process
16. this occurs at around 40% water.
17. Once the nectar reaches 20% water (or less) and the cell is filled
18. the cell is sealed with wax
19. to prevent the honey taking up moisture

*1 mark per line to a maximum of 18*

**(c) Briefly describe the colony prepares the honey for consumption over winter. 3 Marks**

1. cluster moves to stores,

2. uncaps honey,
  3. waters honey down to 50:50,
  4. uses water collected and/or perspiration
- 1 mark per line to a maximum of 3*

- Q17 (a) Name brood and adult bee diseases and their specific effects on bee behaviour. 20  
 (b) Describe how the population of honeybees and brood in a healthy colony varies during the year? 3  
 (c) How might the population change with a severe infection of chalkbrood, from the spring onwards and what would be the impact on the colony and honey harvest? 6

**Q17 (a) Name seven brood and adult bee diseases and give their specific effects on bee behaviour. (6.20) 20**

Disease	Effect
AFB	1. May uncap sealed brood, but cannot remove scale once it is formed. 2. Workers attempt to clean out cells and become contaminated with spores 3. Queen does not lay in infected cells leading to pepper pot brood.
EFB	4. Workers clean out infected larvae. 5. Infected larvae demand more food by moving in the cell and are fed more or removed
Chalk brood	6. Cells are uncapped and chalk brood mummies are removed 7. and left on the hive floor or in front of the hive.
Sacbrood virus	8. Workers can uncap and remove the larvae, 9. doing this infects the adult worker bee 10. and although there is no apparent sign of disease its life is shortened and therefore it stops feeding larvae sooner, 11. it becomes a forager earlier than usual, 12. few infected adults collect pollen.
Nosema	13. The colony dwindles, 14. queen may be superseded having stopped laying, 15. foragers become disorientated. 16. May stop feeding brood which dies.
Chronic bee paralysis virus	17. Type 1: Bees are unable to fly 18. and crawl up grass stems outside the hive with trembling wings and bodies. 19. Bees cluster on top bars 20. Type 2: Bees nibble the hairs of affected bees and 21. force them out of the hive and prevent them returning.
Dysentery	22. Bees defecate in the colony etc

*1 Mark for per name and point to a maximum of 20.*

**(b) Describe how the population of honeybees and brood in a healthy colony varies during the year without swarming? 4 Marks**

1. Jan- March adult numbers greater than brood which is increasing in size
2. April -June brood population overtakes that of adults peaking in June
3. Adult population peaks in July/August
4. Adult population reduces towards year end
5. and brood practically peters out

**(c) How might the population change with a severe infection of chalkbrood, from the spring onwards and what would be the impact on the colony and honey harvest? 6 Marks**

1. Fewer larvae would develop into adults
2. and therefore there would be fewer foragers and less nectar collected.
3. More time would be spent by house bees clearing out infected pupae
4. and infecting the youngest larvae.
5. Eventually, the colony will dwindle out.
6. There will be reduced honey crop for the beekeeper to collect.

*1 mark per line to a maximum of 6*