

Homeostasis 4

Name: _____

Class: _____

Date: _____

Time: **74 minutes**

Marks: **70 marks**

Comments:

1.

This question is about homeostasis.

(a) Define the term homeostasis.

(2)

(b) Name the hormone released if the blood glucose concentration falls too low.

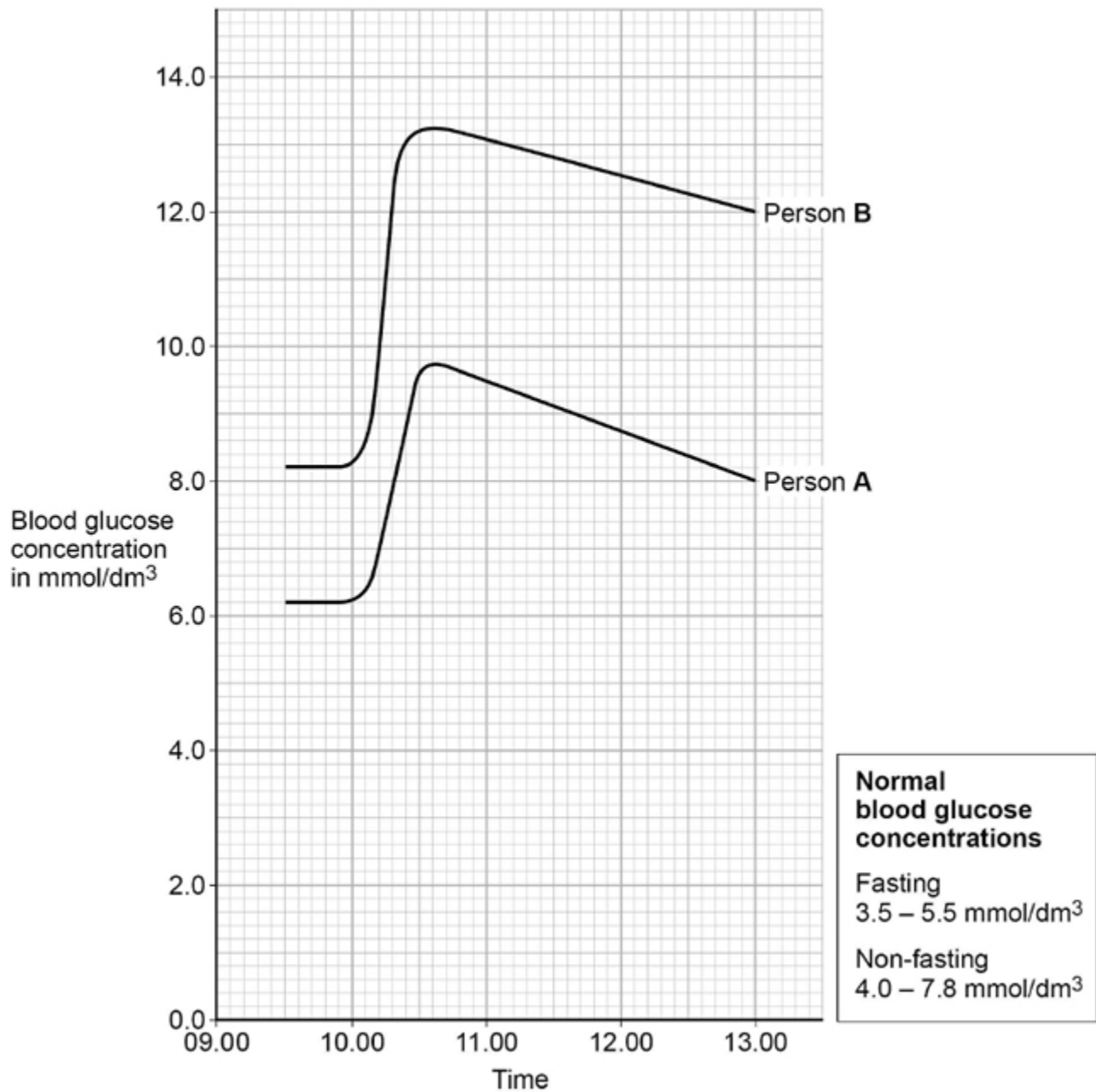
(1)

Two people were sent to a hospital to find out if they have diabetes.

This is the method used at the hospital.

- Do not eat or drink after midnight. This is called fasting.
- Measure blood glucose concentration at 9.30 am
- Drink a glucose solution at 10.00 am
- Measure blood glucose concentration for the next 3 hours.

The graph shows the results.



Person **A** and person **B** have diabetes.

(c) Describe how the graph above shows that person **B** has diabetes.

Use data from the graph.

(3)

(d) Person **A** and person **B** had a test to measure the concentration of insulin in their blood when they were fasting.

The table shows the results.

Person	Fasting blood insulin concentration in arbitrary units
A	280
B	20
Normal range	50–175

Suggest which type of diabetes person **A** and person **B** have.

Give a reason for each answer.

Person **A**

Type of diabetes _____

Reason _____

Person **B**

Type of diabetes _____

Reason _____

(2)

(a) Which label is the cell nucleus?

Tick **one** box.

A

B

C

D

(1)

(b) Which label is the receptor?

Tick **one** box.

A

B

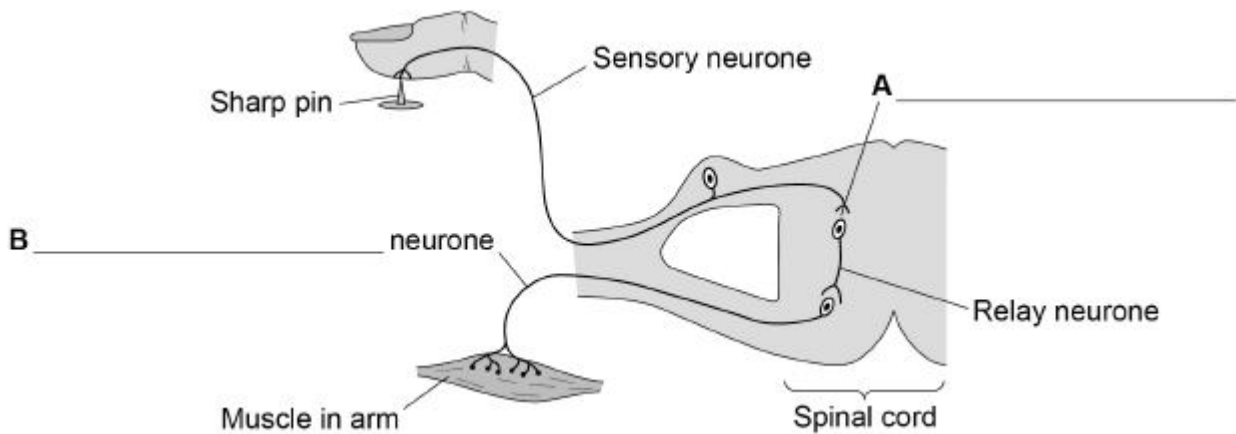
C

D

(1)

(c) **Figure 2** shows the nerve pathway when a person touches a sharp pin.

Figure 2



Name structures **A** and **B** on **Figure 2**

(2)

- (d) When the finger touches the sharp pin, the muscle in the arm contracts to pull the arm away.

What type of action is this?

Tick **two** boxes

- A conscious action
- A delayed action
- A reflex action

(1)

- (e) Doctors tested people of different ages to time how long it took between touching a sharp pin and the arm muscle contracting.

At each age they tested five men and calculated a mean value for the time.

The table below shows the results.

Age in years	Mean time for muscle to contract in milliseconds
20	18
40	20
60	23
80	30

How much longer does it take for the muscle to contract at 80 years of age compared to at 20 years of age?

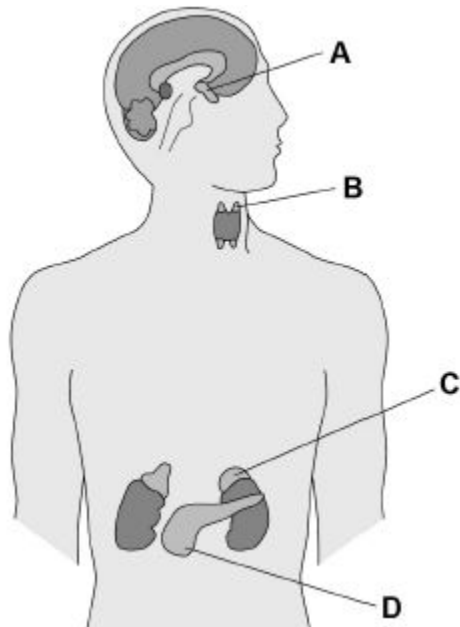
Give your answer in seconds.

Time = _____ s

(2)

(f) **Figure 3** shows the position of some of the glands which release hormones.

Figure 3



Which label on **Figure 3** shows the position of the pituitary gland?

Tick **one** box.

A

B

C

D

(1)

(g) Luteinising hormone (LH) is a hormone released by the pituitary gland.

What is the function of LH?

Tick **one** box.

Controls blood glucose concentration

Controls the formation of sperm

Controls the growth of muscles

Controls the release of an egg

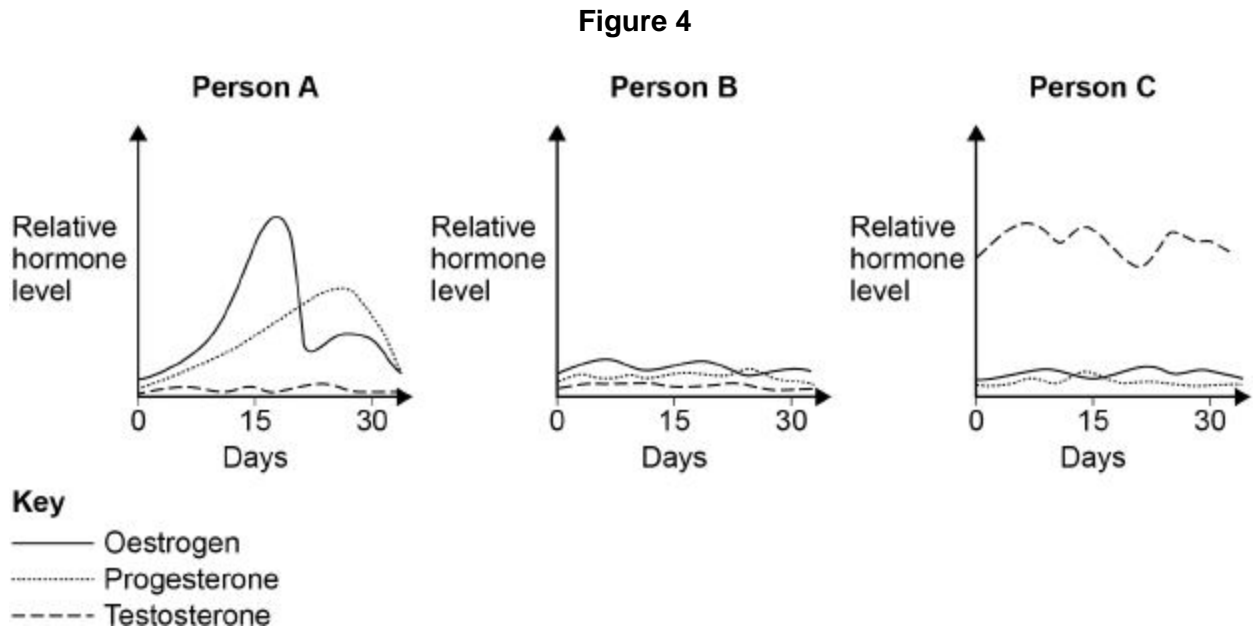
(1)

(h) How does LH travel from the pituitary gland to its target organ?

(1)

(i) **Figure 4** shows the relative levels of sex hormones of three young people over 30 days.

One person is an 8-year-old girl, one is an 18-year-old boy and the other is an 18-year-old girl.



Which person is the 18-year-old boy?

Give **one** reason for your answer.

Person _____

Reason _____

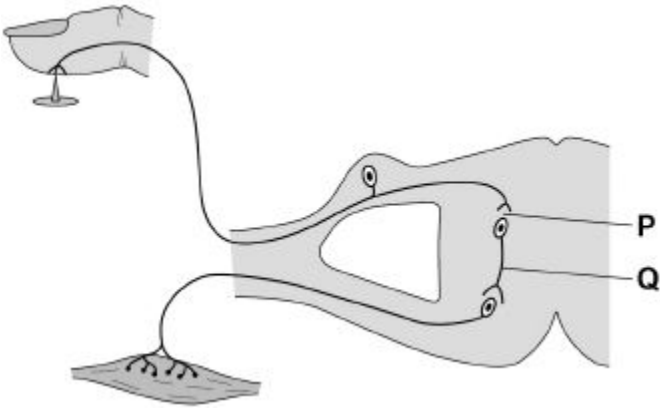
(2)

(Total 12 marks)

3.

This question is about the nervous system.

The diagram below shows a reflex arc.



(a) Name parts **P** and **Q** shown on the diagram above.

P _____

Q _____

(2)

(b) Compare how information is transferred along a neurone with how information is transferred across gap **P**.

(2)

(c) Why does a conscious action take longer than a reflex action?

(1)

(d) Information travels at 120 metres per second in neurones.

Calculate the time it would take for the information to travel 1.6 m along a neurone.

Give your answer in milliseconds.

Time = _____ ms

(3)

(e) Doctors tested people of different ages to time how long it took between touching a sharp pin and the arm muscle contracting.

The table below shows the results.

Age in years	Time for muscle to contract in milliseconds
30	18.9
40	20.2
50	23.1
60	26.7
70	31.3
80	37.0

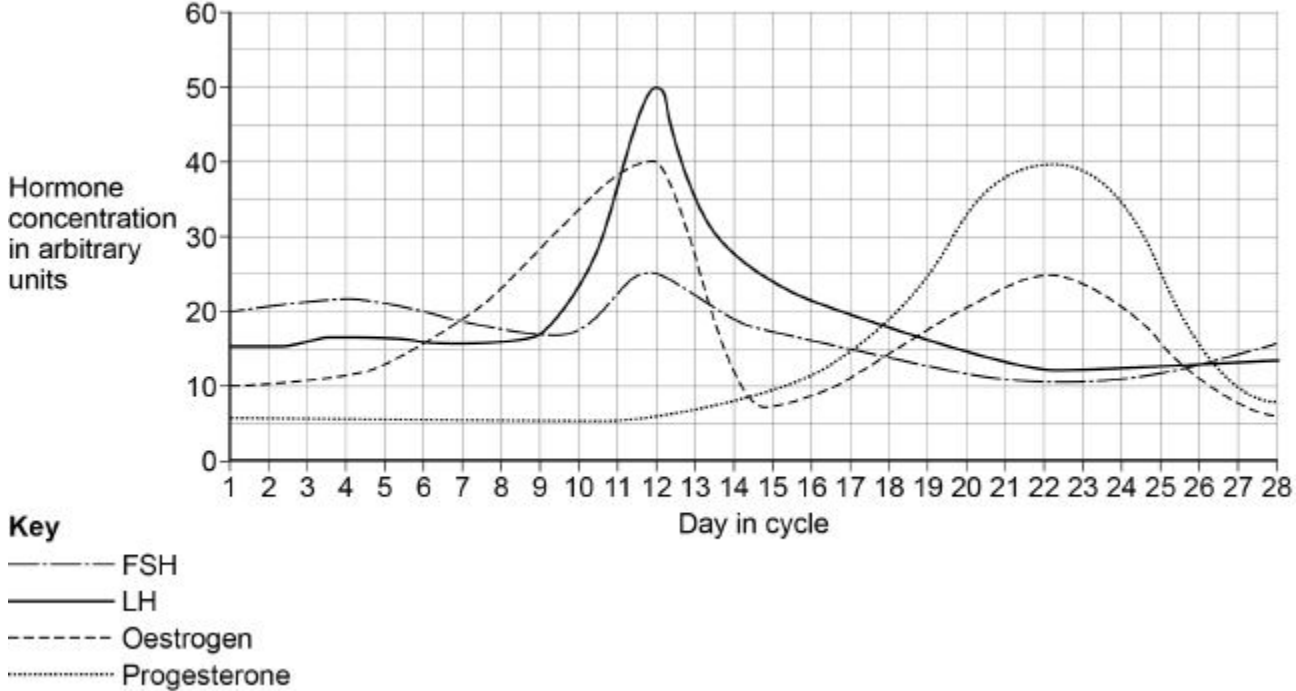
Describe the relationship between age in years and time for the muscle to contract.

(2)

(Total 10 marks)

4.

The graph below shows how hormone concentrations vary during a normal human menstrual cycle if a woman does not become pregnant.



(a) Calculate the rate of increase in LH concentration between day 9 and day 12

Give your answer in arbitrary units per hour.

Give your answer to 2 significant figures.

Rate = _____ arbitrary units per hour

(2)

(a) Draw **one** line from each contraceptive to the method of preventing pregnancy.

Contraceptive device

Method of preventing pregnancy



Contains hormones to stop eggs maturing

Prevents the sperm reaching the egg

Kills sperm

Slows down sperm production

Stops an embryo implanting in the uterus

(3)

The pie chart shows the percentages of people who used different types of contraception in the UK in 2016.

The people are aged 16–49 years.



(b) Determine the percentage of people who used no contraception.

Percentage of people = _____ %

(2)

(c) Suggest **two** reasons why a person aged 16–49 years might **not** be using contraception.

1. _____

2. _____

(2)

The table shows some information about three methods of contraception.

Method	Effectiveness	Other information
Combined pill	99.5%	<ul style="list-style-type: none">• Must be taken every day• Free from your GP or sexual health clinic• May cause headaches
Male condom	98.0%	<ul style="list-style-type: none">• May split or leak• Only used when you have sexual intercourse• Inexpensive in supermarkets or free from a sexual health clinic
Sterilisation	100.0%	<ul style="list-style-type: none">• Needs an operation in hospital• Usually cannot be reversed

6.

This question is about the human nervous system.

(a) A ball is thrown towards a boy.

As the ball is thrown, information passes along a pathway to allow the boy to catch the ball.

Draw **one** line from each action to the correct part of the pathway.

Action	Part of the pathway
Retina cells in the eye detect the light from the ball	Coordinator
The impulse reaches the brain which 'sees' the ball and sends an impulse to the arm muscle	Effector
The muscle in the arm contracts	Response
The arm stretches to catch the ball	Receptor
	Stimulus

(3)

Students in a college made this hypothesis:

'reaction time will increase as the time you have been awake increases.'

The students set up an investigation to test their hypothesis.

This is the method used.

1. Find 5 volunteers willing to stay awake for 24 hours.
 2. Keep the volunteers in a room where they can study, use an exercise bike or watch TV as they wish.
 3. Provide food, water, coffee and tea as requested.
 4. Measure the volunteers' reaction time every 4 hours using a computer program.
- (b) What was the independent variable in this investigation?

(1)

The students used a computer program to test reaction time.

(c) Describe one **other** method that can be used to measure reaction time.

(3)

(d) Which method would you choose to use at your school?

Tick **one** box.

Computer program

Method described in part (c)

Give **one** reason for your choice.

(1)

The table shows the students' results.

Time awake in hours	Reaction time in seconds					
	Volunteer					Mean
	A	B	C	D	E	
0	0.25	0.33	0.35	0.21	0.27	0.28
4	0.20	0.30	0.31	0.19	0.26	0.25
8	0.21	0.28	0.33	0.20	0.27	0.26
12	0.26	0.40	0.58	0.22	0.30	0.35
16	0.44	0.49	0.83	0.27	0.75	X
20	0.64	0.55	1.11	0.39	1.40	0.82
24	0.92	0.61	1.15	0.45	1.35	0.90

(e) Calculate value **X** in the table.

Give your answer to 2 significant figures.

X = _____ seconds

(2)

(f) Describe the pattern of results for mean reaction time as the time awake increases.

(2)

(g) Do these results support the students' hypothesis: 'reaction time will increase as the time you have been awake increases'?

Give **one** reason for your answer.

(1)

(g) Give **two** ways the students could improve their investigation to make it more valid.

1. _____

2. _____

(2)

(Total 15 marks)

Mark schemes

1.

- (a) regulation / control / maintenance of internal conditions (of a cell / body)
allow keeping the internal conditions (of a cell / body) the same

1

for optimum (cell / enzyme activity)

allow description of optimum functioning (of cell / body)

1

- (b) glucagon

correct spelling only

1

- (c) any **two** from:

- fasting blood glucose is higher than normal range
- reached a very high concentration after glucose drink
- did not return to normal after 3 hours
- **or**
- fell slowly after reaching peak.

use of correct data in comparison to normal ranges given for any of the above points

allow \pm half a small square for values quoted from the graph

1

ignore references to person A

2

- (d) (person A has Type) 2 (pancreas) producing (lots of) insulin but body cells cannot respond to it.

*allow cells becoming resistant to insulin for respond to insulin. do **not** accept the person has become resistant to insulin*

1

(person B has Type) 1 (pancreas) not producing enough insulin (to control concentration of glucose in the blood)

1

type of diabetes must be correct

- (e) starving children have used up their glycogen stores
allow starving children have no / low glycogen stores 1
- (so) would need (liver enzyme) to release glucose from fats 1
- as enzyme is stopped from working they get low / no glucose
allow no working enzyme leads to hypoglycaemia 1
- (cell) respiration is insufficient (so they die)
allow starving children use proteins to release energy (which leads to death) 1
- children that are not starving have glycogen stores in liver / muscle 1
- (so) glucagon will continue to release glucose (into the blood for them) 1

[14]

- 2.** (a) A 1
- (b) D 1
- (c) A = synapse 1
- B = motor (neurone) 1
- in this order only*
- (d) a reflex action 1
- (e) 12 (ms) 1
- 0.012 (s) 1
- an answer of 0.012 (s) scores 2 marks*
- (f) A 1
- (g) controls the release of an egg 1
- (h) in the blood(stream)
allow in the plasma / blood vessels
*do **not** accept in blood cells / platelets* 1

(i) (person) C

1

any **one** from:

- the testosterone level is high(er)
allow testosterone is the main male (sex) hormone
- the oestrogen **and / or** progesterone levels are low
- the oestrogen and progesterone levels do not rise and fall as they do in a menstrual cycle

allow there is no menstrual cycle

1

no marks if A or B given

[12]

3.

(a) (P) synapse

1

(Q) relay neuron(e)

allow intermediate neuron(e)

1

allow phonetic spelling

(b) (in neurone) as electrical impulse

allow electrical potential

ignore signal / message

1

(across synapse / gap P) as diffusion / movement of chemical / neurotransmitter

1

if no mark awarded allow 1 mark for mention of electrical and chemical in that order

(c) the impulse has to travel to the brain (and back)

allow it needs time to be processed by the brain

allow the pathway is (a lot) longer

allow more synapses

1

(d) $120 = \frac{1.6}{\text{time}}$

or

evidence of: $\text{speed} = \frac{\text{distance}}{\text{time}}$

1

0.013(33...)(s) **or** $\frac{1}{75}$

1

13(.33...) (ms)

an incorrect answer correctly converted to ms scores 1 mark

1

- (e) as age (in years) increases the time for the muscle to contract increases
*do **not** accept directly proportional*

1

at an increasing rate

allow correct description of 'at an increasing rate'

1

[10]

4.

(a) $\frac{33}{72}$

or

0.45833...

allow $\frac{34}{72}$

or

0.47222...

1

0.46 (arbitrary units per hour)

allow 0.47 (arbitrary units per hour)

allow an answer given to 2 significant figures from an incorrect calculation in step 1 for 1 mark

1

- (b) any **five** from:
- (during the first days of the cycle) FSH from the pituitary stimulates an egg / follicle to mature
 - FSH stimulates oestrogen from the ovaries
 - oestrogen causes thickening of the uterus lining (in the first half of the cycle)
 - oestrogen inhibits FSH but stimulates LH from the pituitary
 - the high levels of LH stimulate release of the egg / ovulation (on day 14))
 - progesterone is secreted by the (empty) follicle / corpus luteum (after day 14 / ovulation)
 - progesterone maintains the lining of the uterus (during the second half of the cycle)
- or**
- progesterone inhibits both FSH and LH
 - progesterone falls (if no pregnancy happens) and uterus lining comes away as the menstrual blood flow

if no other marks awarded allow 1 mark for oestrogen and progesterone are produced by the ovaries and FSH and LH are produced by the pituitary

5

points must be in correct order to gain full credit

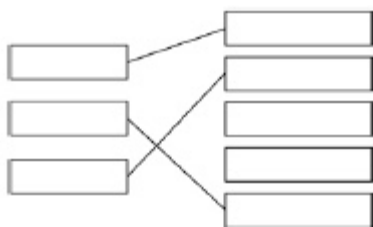
- (c) any **one** from:
- (lower dose so) fewer side effects
 - (patch lasts longer so) don't have to remember to take pill every day
 - hormone (from patch) goes directly into bloodstream so (contraception) unaffected by vomiting

1

[8]

5.

(a)



1

1

1

(b) 23%

allow 1 mark for evidence of pill + condom = 180%/50%

2

- (c) any **two** from:
- want to have a baby
 - not having sex
 - past the menopause
 - pregnant

allow any sensible reason

2

(d)

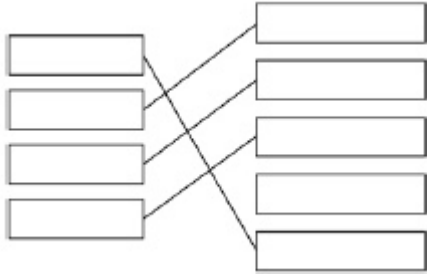
Level 2: Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.	3-4
Level 1: Relevant features are identified and differences noted.	1-2
No relevant content	0
<p>Indicative content</p> <p>combined pill</p> <ul style="list-style-type: none"> • A – easy to take, very effective and free on NHS, but • D – it can cause headaches/side effects, must remember to take it every day <p>condom</p> <ul style="list-style-type: none"> • A – only need it when you have sex, no side effects, very inexpensive, but • D – it is not as reliable, more difficult to use <p>sterilisation</p> <ul style="list-style-type: none"> • A – 100% effective but • D – probably will not be able to have a family, risks of surgery 	

4

[11]

6.

(a)



4 correct = 3 marks
3 correct = 2 marks
2 correct = 1 mark
(4-5)

3

(b) time awake

1

(c) description of how to do a 'ruler drop'

1

how to measure length in cm

1

a control measure taken

or

how to use a conversion chart to get reaction time

1

(d) any **one** sensible reason:

for ruler drop test:

- have lots of equipment
- inexpensive equipment
- many students can do it at same time

for computer test:

- more accurate
- more repeatable
- students can cheat on ruler drop test

1

(e) 0.556..... or

$(0.44+0.49+0.83+0.27+0.75)/5$

1

0.56

an answer of 0.56 scores 2 marks

1

- (f) at first stays same / has slight dip (until 12 hours)
12 hours only needed once 1
- increases from 12 hours awake
ignore 'increases' alone 1
- (g) **either:**
does support, because overall goes up
or
does not support, because it goes down / stays the same at first and only goes up after 12 hours 1
- (h) any **two** from:
- use more volunteers
 - make sure they all do the same activities at the same time
 - give them the same food and coffee/tea at the same time
 - control the age / gender of volunteers
 - make sure they all had a good night's sleep the night before the investigation began 2

[15]