A-Level Biology

Regulation of Transcription and Translation

Mark Scheme

Time available: 62 minutes
Marks available: 47 marks

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1.

(a) 1. Correct answer of 625 = **2 marks**;;

2. Shows 625 but decimal point incorrect = **1 mark**

OR

Working shows 40 = **1 mark**

OR

1600/1.6 = **1 mark**

OR

667/666.6 = **1 mark**;

2

(b) (Cell/membrane has a) phospholipid bilayer

OR

No channel/carrier protein (for uptake)

OR

No need for channel/carrier protein (for uptake);

1

(c) 1. Both are more effective than the control;

Mark points 4 to 10 = 4 max.

Accept both (results) are below the control.

2. Differences in the means not (likely to be) due to chance

OR

Significant difference (in effectiveness between both types);

Reject 'results are significant'.

Accept significantly higher or significantly lower in correct context.

3. (As) SDs do not overlap;

Accept error bars do not overlap.

4. HBsAg (reduced), not zero

OR

Replication (reduced), not zero;

5. Not (investigated in) humans

OR

(Investigated in) mice;

6. shRNA (more effective as) 7.5% (of control) compared with 50% for lhRNA;

Accept 42.5% difference.

Accept (mean) concentration for %.

7. No indication of sample size/number;

8. Long term effects not known

OR

Side effects not known;

Accept 'could be toxic' for side effects not known.

9. No statistical test to determine significance;

10. (Investigated) in vitro

OR

Not (investigated) in vivo;

Accept not done inside an organism or not done in liver (organ) but 'only tested in liver cells' is insufficient unless qualified.

Ignore only 'one study' or 'no repeats'.

5 max

[8]

2. (a) 1. Heritable changes in gene function;

2. Without changes to the base sequence of DNA;

2

(b)

Control element	Binds with DNA	Binds with protein
Oestrogen		✓
Methyl groups	✓	
Acetyl groups		✓

1 mark for each correct column.

Accept both boxes ticked in oestrogen row.

2

(c) 1. Methyl groups (could be) added to (both copies of) a tumour suppressor gene;

2. The transcription of tumour suppressor genes is inhibited;

3. Leading to uncontrolled cell division.

3

(d) Cells of benign tumours cannot spread to other parts of the body / metastasise;
OR
Cells of benign tumours cannot invade neighbouring tissues.

Accept answers clearly in the context of malignant tumours.

1

[8]

3. (a) 1. Binding (of interferon gamma) changes shape/tertiary structure of receptor (protein);
2. This activates/switches on the enzyme;
3. Use of ATP (to phosphorylate STAT1);

1. Accept reference to second messenger mechanism/process

3. Context is important

2 max

(b) 1. Phosphorylated STAT1;
2. IRF (protein);

Accept in either order

1. Must be phosphorylated but accept STAT1P

2. Ignore references to phosphorylated

2

(c) 1. Causes more helper T cells to form;
2. (So) more interferon (gamma) production (by helper T cells);

1. and 2. require idea of more

2

(d) 1. (Tumour suppressor gene) slows cell division/causes death of damaged/tumour/cancer cells;
2. *IRF* gene leads to formation of IRF (protein) that binds to gene B;
3. (Gene B protein) causes death of damaged/mutated cells OR slows division;

2. 'It' means IRF gene

3. Context is important

*3. If clearly stated **and** includes the protein, scores 2 marks because it subsumes point 1*

3

[9]

4. (a) Cytosine with Guanine and (Adenine) with Uracil;

Ignore G, C and U

1

(b) Two reasons, with suitable amplification;;

Q

Only infected cells have HIV protein on surface;

So carrier only attaches to / specific to these cells / siRNA can only enter these cells;

OR

siRNA (base sequence) complementary / specific to one mRNA;

Accept idea of specificity

Only infected cells contain mRNA of HIV / this gene / stops translation of this gene / only binds to this mRNA / destroys this mRNA;

Accept could not inhibit other / non-HIV mRNA

4 max

(c) 1. Carrier binds to (protein on) HIV;

1. Accept references to HIV membrane

2. Prevents HIV / it binding to (receptor on human) cell;

2. Reject references to binding to HIV protein on human cell

2

[7]

5. (a) RNA polymerase;

DNA polymerase is incorrect
Ignore references to RNA dependent or DNA dependent
Allow phonetic spelling

1

(b) (i) (Receptor / transcription factor) binds to promoter which stimulates RNA polymerase / enzyme X;

Transcribes gene / increase transcription;

2

(ii) Other cells do not have the / oestrogen / ERα receptors;

But do not accept receptors in general.

1

(c) Similar shape to oestrogen;

Binds receptor / prevents oestrogen binding;

Receptor not activated / will not attach to promoter / no transcription;

Accept alternative
Complementary to oestrogen;
Binds to oestrogen;
Will not fit receptor;

2 max

[6]

6. (a) 1. Lipid soluble;

Ignore 'not water soluble' or 'fat soluble'.

2. (Diffuse through) phospholipid (bilayer);

Ignore reference to joining to receptors/channels/carriers but reject passage through protein channels/carriers.

2

(b) 1. Has a (specific) tertiary structure/shape;

Accept in context of AR or testosterone.

Ignore 3D.

2. (Structures are) complementary;

Reject reference to antigen.

Reject reference to active site, enzyme, substrate or induced fit.

2

(c) 1. (AR is) a transcription factor;

Ignore 'binds to bases' or 'binds to gene'.

2. Binds to DNA/promoter;

Reject reference to active site, enzyme, substrate or induced fit.

3. (Stimulates) RNA polymerase;

2 max

(d) 1. With 16 or fewer than 16 (repeats the association) is significant;

*If none of the marks is awarded allow principle mark of (prostate) cancer more likely with 16 or less than 16 (repeats) **or** (prostate) cancer less likely with 17 or more than 17 (repeats)*

OR

*Alternative principle mark Correctly links significant/not significant to correct probability value/percentage **or** to rejecting/accepting the null hypothesis.*

Reject 'the results are significant'.

Accept 'difference in results is significant'.

2. *With 17 or more than 17 (repeats the association) is **not** significant;

3. *With 16 or fewer than 16 (repeats) there is less than a 5% or less than 0.05 probability of being due to chance

OR

*With 17 or more than 17 (repeats) there is more than a 5% or more than 0.05 probability of being due to chance

OR

*Explanation of a probability value e.g. 0.30 is a 0.30 or 30% probability of being due to chance;

Accept equivalent responses in terms of 95% or 0.95 probability.

4. *With 16 or fewer than 16 (repeats) reject the null hypothesis

OR

*With 17 or more (repeats) accept the null hypothesis;

**Accept reference to any number of repeats (e.g. 18) between 17 to 20 for 17 or more than 17 (repeats).*

3 max

[9]