



PHYSICS

GENERAL COURSE

Marking key for the Externally set task
Sample 2016

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Physics

Externally set task – marking key

1. Racing bikes are usually made from lightweight materials like aluminium or carbon fibre.

(a) Use physics concepts to explain how this helps the cyclist ride faster.

Description	Marks
Smaller mass requires a smaller force to move it	1
According to $F=ma$	1
OR other relevant explanation such as momentum, Newton's Second Law	
Total	2

(b) Cyclists try to decrease air resistance acting against them. Identify two ways they could do this.

Description	Marks
Wear tight clothing, crouch down/streamline their body/hold arms in, knees close to body, shave body hair, wear streamlined helmets, sit in line behind another cyclist	Any 2 x 1
Total	2

(c) Cyclists are required to wear a helmet to protect their head if they have an accident. Use physics principles to explain how the inner layer of the helmet helps to protect the cyclist's head from injury.

Description	Marks
The cyclist's head has momentum which decreases to zero when it collides with something	1
The inner layer of the helmet increases the time it takes for the head to reach zero velocity	1
Since change in momentum, $\Delta p = Ft$	1
If time is increased, force to the head will decrease	1
So less damage is done to the head	1
Total	5

(d) The graph below shows a cyclist's velocity during a ride which lasted one hour. During this ride, Katie the cyclist, accelerated as she rode down a hill, rode at a steady speed for a while, stopped to have a drink and braked suddenly to avoid a pedestrian.

Looking at the graph, answer the following questions.

- (i) How long did Katie stop for a drink? (1 mark)
- (ii) At what time did Katie brake suddenly and stop? (1 mark)
- (iii) At what speed does Katie travel when she is cycling at a steady speed? (1 mark)
- (iv) Using the speed from (iii), calculate the distance Katie would cover in 5 minutes (300 seconds). Show your working and express the answer in metres and also in kilometres. (4 marks)

Description	Marks
(i) 10 minutes (or from 20 – 30 minutes)	1
(ii) 36 minutes	1
(iii) 15 ms^{-1}	1
(iv) $s = vt$	1
= 15×300	1
= 4500 m	1
= 4.5 km	1
Total	7

2. Sam and Jen are having a discussion about whose bicycle has the best brakes. They decide to do an investigation to find out more.

(a) Design an experiment to test the braking power of a bicycle. You will need to write a step-by-step method of how the experiment will be carried out, and make a list of the equipment required.

Description	Marks
Equipment: measuring tape, stopwatch, bicycle and rider, track	4
Method: rider cycles at a steady speed past a point	
Applies the brakes at that point	1
The time for bike to stop is timed/ the distance for bike to stop is marked and measured	1
Initial speed of cyclist is determined by measuring the time taken to cover a set distance (5–10m or more) and calculating it to verify controlled variable	1
	1
Total	8

(b) List **four (4)** variables which will need to be controlled during this investigation.

Description	Marks
Same bicycle, track surface, speed of bicycle, weight of rider, slope of track	1 each
Total	4

(c) Which variable is the dependent variable, or the one you will measure?

Description	Marks
Time or distance for bicycle to stop	1
Total	1

(d) Draw up a table to enter the results.

Description	Marks
Minimum 2 columns labelled	2
Average stopping time or distance	1
Total	3

- (e) Show the formula you would use to calculate the bike's acceleration while it is braking, using the variable that you measured. No calculations are required.

Description	Marks
Appropriate formula for measured variable ($v = u + at$ for time, or $v^2 = u^2 + 2as$ for distance)	1
Total	1

- (f) Will the bike's acceleration during braking be positive or negative? Explain.

Description	Marks
Negative	1
Final speed is greater than initial speed (or other explanation)	1
Total	2

- (g) How will Sam and Jen decide which bike has the best brakes?

Description	Marks
Choose the bicycle which has the shortest average stopping time or distance, or the highest deceleration.	1
Total	1

- (h) Draw a diagram of all the forces acting on the bicycle while the brakes are being applied. Represent the forces using labelled arrows to show the direction of each force and indicate the relative sizes of the forces by the length of the arrows.

Description	Marks
Brake force, air resistance in opposite direction to motion	2
Air resistance smaller than braking force	1
Gravity down, reaction force up	2
Arrows equal size	1
Total	6