Bicycles

No More Traffic Jams ...

With so many cars on the road it seems that driving to work is more about sitting in traffic than actually getting anywhere. That's why more and more commuters are hopping on their bikes for speedy, traffic jam-free journeys to work and back.

What you have to do

Your friend's had a great idea to make a bit of money. He wants to set up a small business in the centre of town to sell cheap, second-hand bikes to commuters.

The cheapest way, he reckons, is to make bikes by recycling bike parts. If he wants to sell them, they must work and be safe. That's why he wants your help.

He's asked you to select one test from the following list and design the relevant testing machine. Or, if you want to work in a group, you can design testing machines for all three.

1. Static load test on wheel. This is to make sure your wheels won't buckle too easily.
2. Saddle strength test. Believe it or not, this one tests the strength of your saddle.
3. Impact test (falling frame/fork assembly). This tests whether or not your frame and front fork can withstand a sudden impact like, for example, the sort of impact that happens when you pull a 'wheelie' and land again.

Each test is based on tests described in the British Standard BS6102-1:1992 Cycles; Specification for safety requirements for bicycles. You can find the relevant modified extracts from the standard at the end of this assignment sheet.

The standard actually contains lots more safety tests for many other bike bits - but your friend wants to see your craftsmanship before commissioning you to design machines for them all!

Design Brief

Each testing machine must:

- test a specific bike part to see if it meets acceptable safety standards (based on BS6102-1:1992 Cycles; Specification for safety requirements for bicycles)
- be hard wearing so it can be used many times
- be safe to use, and come with clearly marked warnings and instructions for the user
- come with maintenance instructions

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Bicycles

Design brief continued ...

Functionality is more important than aesthetics. However, the product should have some form of branding and, if designing more than one machine, there should be a consistency in the way they look.

The machines should be marketable. The target audience would be small companies manufacturing and/or selling bikes.

Cost should be kept as low as possible, and must be under £100 for each testing machine.

The machines should be small enough to use in a small- to medium-sized workshop (about 15 m^2), alongside other similar machines.

How to set about it ...

What exactly do they want?

1. Draw a table like the one below (you may need more rows). Use the first column to list the **key design features** from the **design brief**. In the second column, "Initial thoughts", make a few notes about what you'll have to bear in mind as you begin to come up with possible solutions.

Key design feature	Initial thoughts

2. You can now write your **design specification**. This should explain exactly what's required, and the implications of each design feature.

Generating ideas and shortlisting

3. Using the internet, library and/or resource centre, carry out some research into bike testing machines. Here are a few places you might like to try:

   http://www.bmd.nl/ (manufacture various bike testing machines. Good to get an idea of size and aesthetics)

   http://www.efbe.de/ehomepag.htm (a German page, but mostly in English. Has information about bike testing)

   http://www.cpsc.gov/businfo/regsumbicycles.pdf (a pdf. file explaining some of the requirements for American safety standard compliance)

4. Produce a number of **design ideas** using simple freehand sketches to try to visualise them.
5. Shortlist three of your ideas, explaining the decisions behind your choices. Even at this stage you should be pretty sure your design ideas will work. Scientific principles will help, for example forces, levers and moments.

Bicycles

And then there was one ...

6. You must now work out the pros and cons of your three design ideas. There are a number of ways to help you work these out. A few of them are:
   - You could carry out simple tests on models of particular components. For example, to evaluate methods of holding bike parts during testing. In some cases you may want to test a scale model of the whole structure.
   - Think about costs. Which of your three designs for testing machines would be most expensive to manufacture?
   - What's the rough life expectancy of your different designs? Is one much more hard-wearing than another?
   - Do any of your designs have more than one use? You've designed each machine to carry out a particular test for a specific bike component. But could they be used for anything else?
7. Having weighed up the pros and cons, you've probably got a decent idea which design you think is the best. But the client is the paymaster. So, to help choose a final design solution, you should get feedback (comments and suggestions) from an expert who understands your client's needs.
   - Make 2-D and 3-D drawings and/or scale models of your three design ideas. These should be of good enough quality to allow you (and anybody else for that matter) to visualise exactly what your testing machines will look like.
   - Present your designs to the expert, and write down their comments and suggestions. (but if you're adamant one design is better than another, make sure you can explain why - you have to give the client what they want, but YOU are the designer!).
   - Consider the expert feedback and decide what modifications you need to make, if any, to make sure your designs meet the client's needs.
8. Choose your final design solution and summarise the reasons behind the choice, including how your **design solution** fulfils the **key design features** in your **design specification**, and how you've used expert feedback.

Presenting your solution

9. Decide on a suitable engineering drawing technique to present your final solution. Make 2-D and 3-D engineering design drawings, or use computer aided design (CAD) to produce them. Make sure you stick to engineering standards and conventions.

Bicycles

You've done the design job ...

10. You've successfully produced a **design solution** from a **design brief**. But what now? You've done the job of the designer, so you need to put your engineer's hat on. The design solution has to be turned into a **product specification** - giving the manufacturer the information needed to actually make the product.

    A product specification details all the materials needed to make a product; it includes its dimensions, tolerances and details of how the different components will be joined together.

    You need to decide which materials will be best to make your testing machine. To decide which materials are best you should look back at the design brief and your initial research. You should also use databases and other resources to find out properties of materials.

    You might also want to try tests for materials, joints and finishes to show how these can vary and influence your choice for the product specification.

    COMPARATIVE TESTS

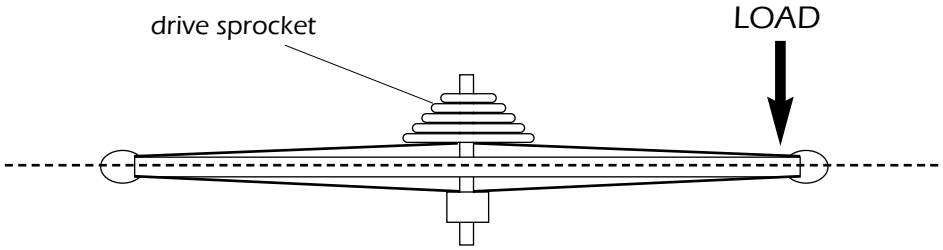
Bicycles

BS6102-1:1992

The following diagrams and extracts are based on diagrams and text from British Standard BS6102-1:1992 Cycles; Specification for safety requirements for bicycles.

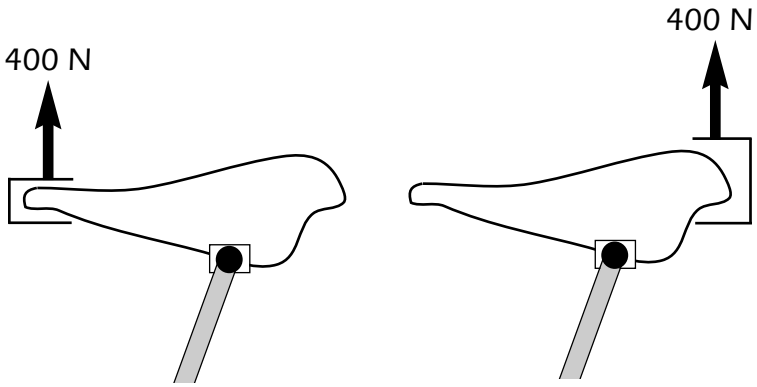
NOTE: They are **not** exact copies, and the text has been altered.

Static load test on wheel



BS BS6102-1:1992 says, "with the wheel suitably supported and clamped in position a force of 178 N shall be applied on the side of the drive sprocket at one point on the wheel rim, perpendicular to the plane of the wheel. The force shall be applied once only for a duration of one minute." The diagram above should help you.

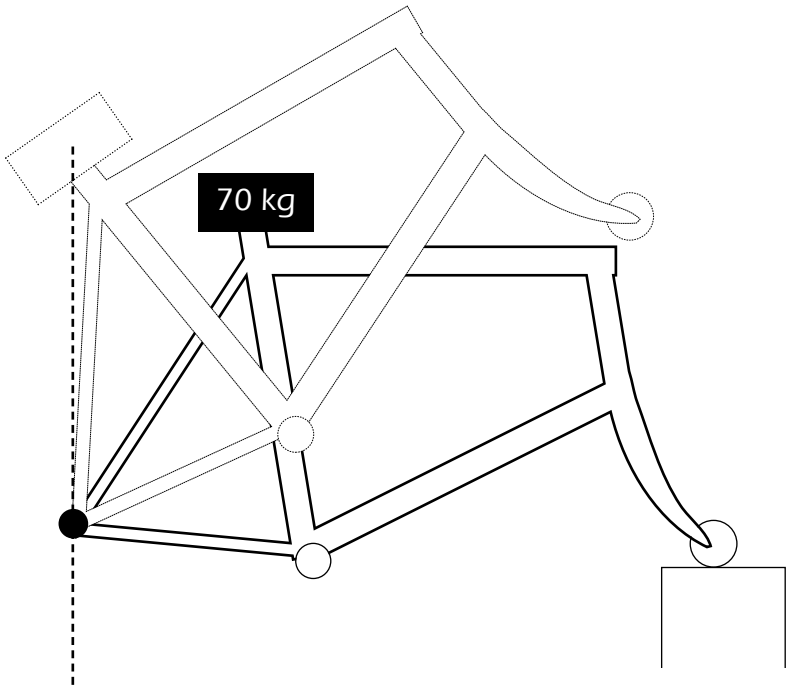
Saddle strength test



BS BS6102-1:1992 says, "with the saddle clamped to a fixture .... a force of 400 N shall be applied in turn under the rear and nose of the saddle cover. The force shall not be applied to any part of the wire chassis of the saddle". The diagram above should help you.

Bicycles

Falling frame/fork assembly



BS BS6102-1:1992 says, "assembly shall be mounted at the rear axle attachment points so it is free to rotate about the rear axle, in a vertical plane. The front fork shall be supported ... so the frame is in its normal position of use. A mass of 70 kg shall be securely fixed to the saddle pillar with its centre of gravity on the axis of the seat tube. The assembly shall be rotated about its rear axle so the centre of gravity of the 70 kg mass is vertically above the rear axle, and then be allowed to fall freely so it impacts on the front support" The diagram above should help you.