Power from the wind

1 A windfarm generates electrical power from the wind.

(a) State **one** disadvantage of using the wind to generate electrical power.

(1)

.....

.....

(b) A windfarm generates 322 MW of electrical power.

The windfarm is connected to a transmission line at a potential difference of 132 kV.

(i) Calculate the current from the windfarm.

(3)

current = ... A

(ii) The windfarm produces 322 MW of power.
The windfarm is to be extended by adding 75 improved turbines.
The extended windfarm will then produce a total of 539 MW.

Calculate the power produced by each improved turbine.

(2)

power = ... MW

*(c) There is a plan to replace the existing transmission line from the windfarm with one at the higher potential difference of 400 kV.

The new transmission line will cross more than 200 km of mountains.
The cables will hang 50 m above the ground from 600 new, taller pylons.
Eventually, about 1000 of the old, shorter pylons will be removed.

Discuss the advantages and disadvantages of this plan.

(6)

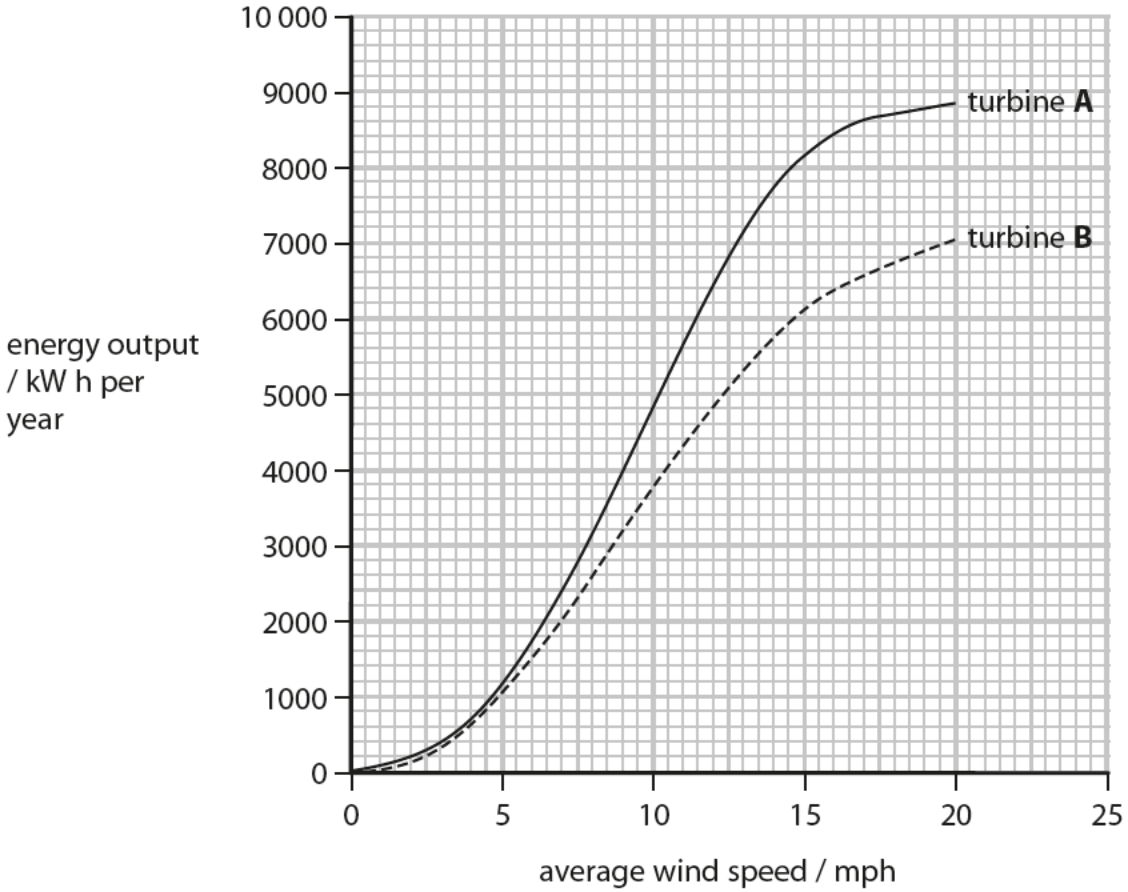
(Total for Question 5 = 12 marks)

Generating electrical energy

2 (a) Eric owns a small farm where chicks are hatched from eggs.

He is considering generating his own electricity to heat and light a barn rather than using electricity from the National Grid.

This graph shows how the energy output varies with wind speed for two different wind turbines, **A** and **B**.



The average wind speed at Eric's farm is 13 mph.
The total heating and lighting in the barn requires 6000 kW h of electrical energy each year.

(i) Use the data in the graph to recommend the best turbine for Eric's barn.

(1)

The best turbine is ..... because.....

.....

.....

(ii) Eric pays 14p per kW h for electrical energy supplied by the National Grid.
Calculate how much he could expect to save each year by using the energy from this wind turbine to heat and light the barn.

(2)

annual saving = £.....

(iii) Eric looks at the cost of installing the turbine.

State how he should work out the payback time.

(1)

.....

.....

(iv) The chicks need to be kept warm at all times.
Eric uses halogen lamps to provide heat and light for most of the day.
Eric thinks about changing his halogen lamps for energy saving lamps.
Suggest why this might not actually be a benefit.

(2)

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*(b) There are several large-scale energy resources which are suitable alternatives to fossil fuels in some situations.
Two of these alternatives are hydro-electric power and solar power.

Compare hydro-electric power with solar power as energy resources for the large-scale generation of electricity.

(6)

(Total for Question 6 = 12 marks)

3 A student investigates how the average speed of the trolley varies with starting height.

Figure 9 shows the trolley and runway.

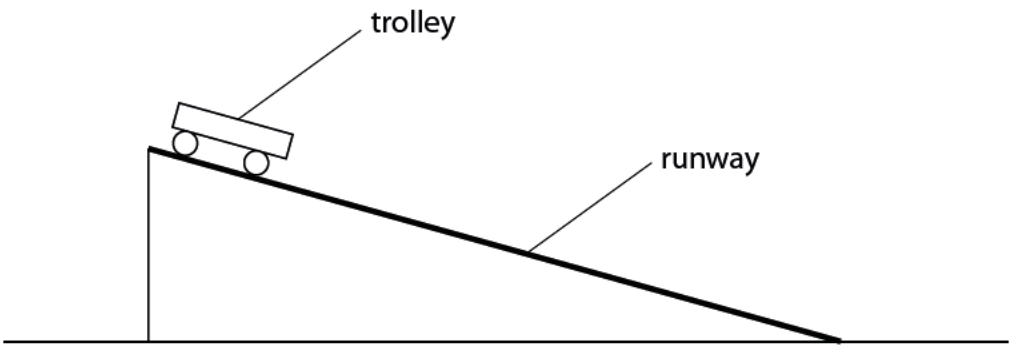

Figure 9

(a) Describe how the student can determine the average speed of the trolley.

(4)

(b) Figure 10 shows his results.

starting height / m	v / ms^{-1}
0.01	0.22
0.02	0.31
0.04	0.44
0.09	0.66
0.12	0.77
0.14	0.83
0.18	0.94

Figure 10

Figure 11 shows the student's graph.

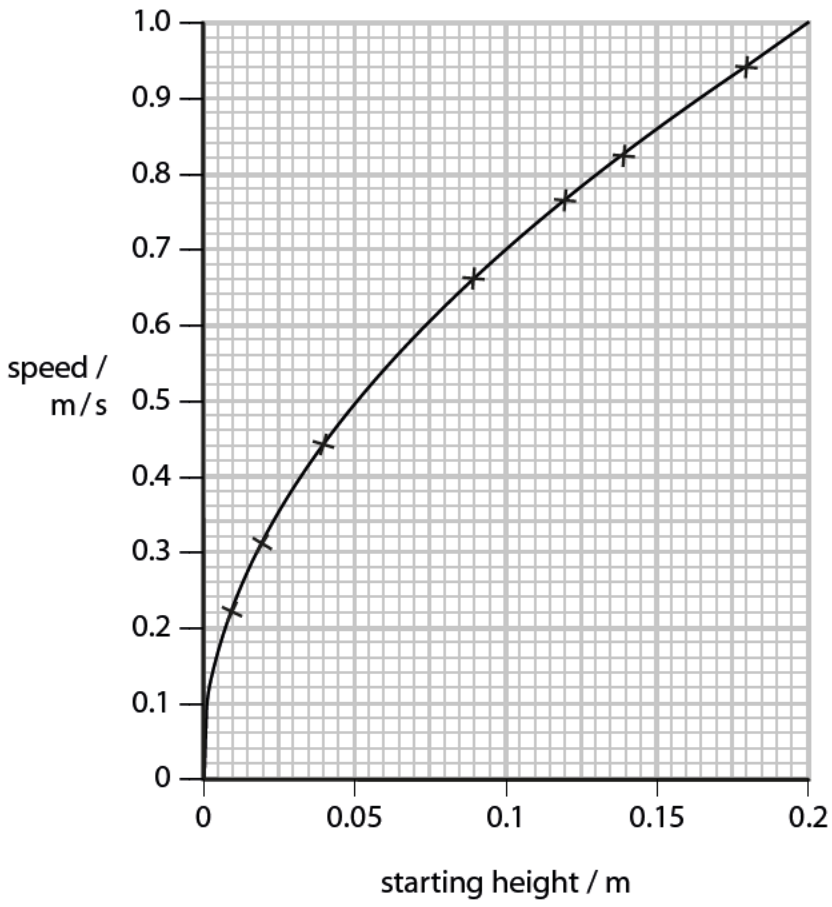

Figure 11

Calculate th g height of 0.075 m.

(2)

average kinetic energy= ..... J

(ii) Determine the gradient of the graph when the height is 0.1 m.

(2)

gradient = ...

(iii) Describe how the speed of the trolley varies with the changes in height made by the student between 0.04 m and 0.12 m.

(2)

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.....

.....

(c) The student wants to change his experiment to investigate how different surfaces of the runway affect the speed of the trolley down the slope.

Devise an experiment that would allow him to investigate the effect of different surfaces on the average speed of the trolley.

(3)

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(Total for Question 7 = 13 marks)