



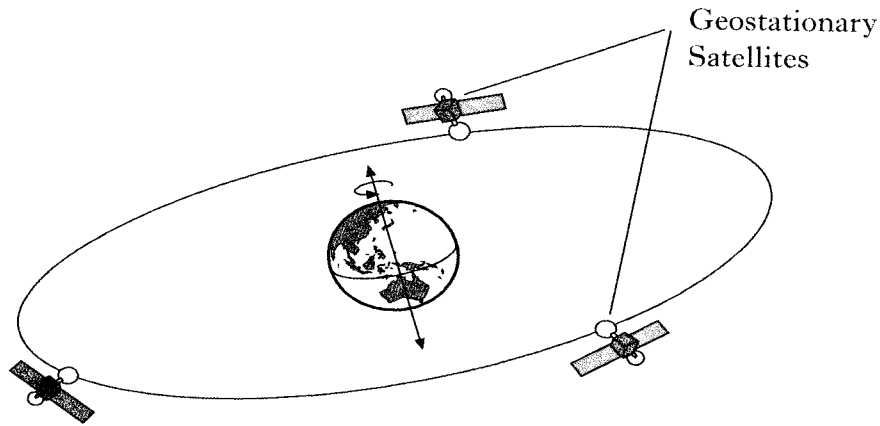
**National 4  
Physics**

**Solutions to  
KU Revision Questions  
for Dynamics & Space  
Unit Assessment**

## 21. (continued)

Marks

- (c) Television signals from the Rugby World Cup in New Zealand are sent via geostationary satellites to Scotland.



- (i) What is meant by a geostationary satellite?

A satellite that stays above  
the same point on Earth's surface  
or  
A satellite with period of 24 hours.

1

- (ii) When live interviews take place, there is a delay between the interviewer in Scotland asking a question and the person hearing the question.

Explain why there is a delay.

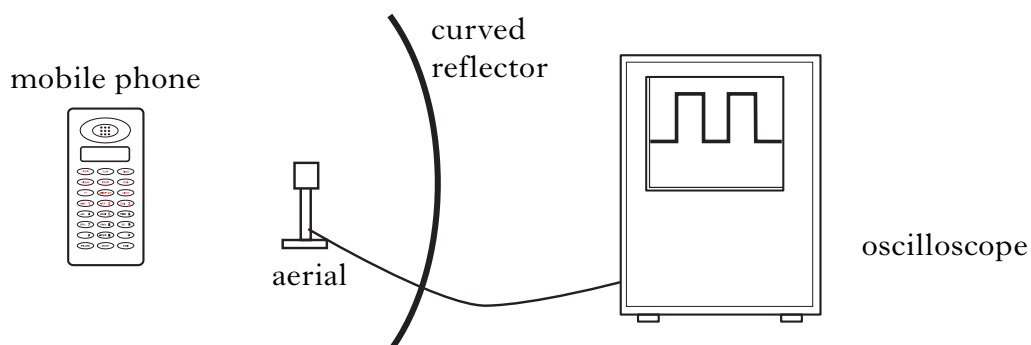
The signal must be sent up to  
the satellite and passed to  
another satellite before it is  
sent back down to Earth

2

[Turn over]

**21. (continued)***Marks*

- (d) In an experiment to investigate mobile phone signals, a student sets up the following equipment. The mobile phone transmits signals as pulses.

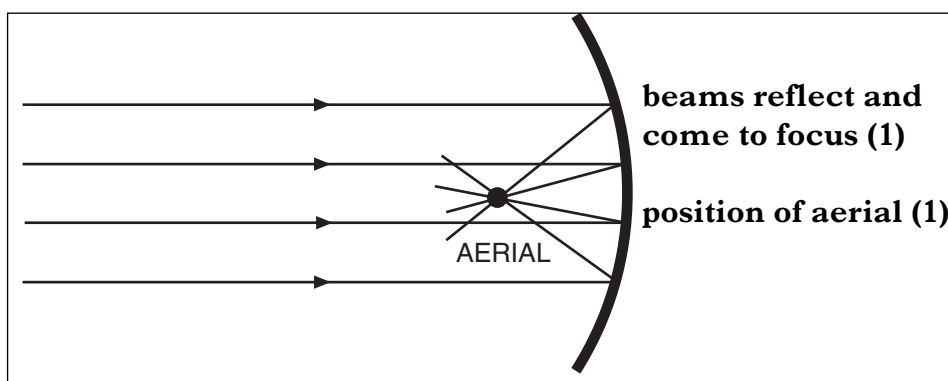


- (i) Why is there a curved reflector behind the aerial?

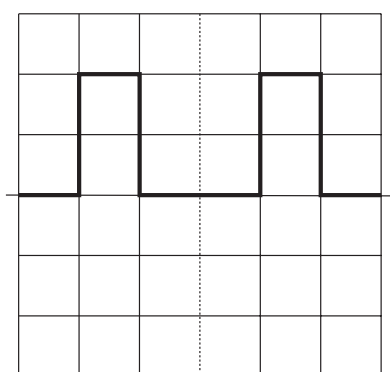
**to make the signal stronger OR to direct the signals to the aerial**

**1**

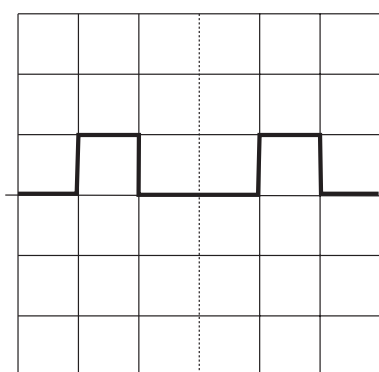
- (ii) Complete the diagram below to show how the curved reflector affects the signals. On your diagram mark where the aerial should be positioned to get the strongest signal.

**2**

- (iii) On the blank oscilloscope grid below, draw the signal that you would expect to see if the curved reflector was removed.



Signal received when a curved reflector is used.



Signal received with curved reflector removed.

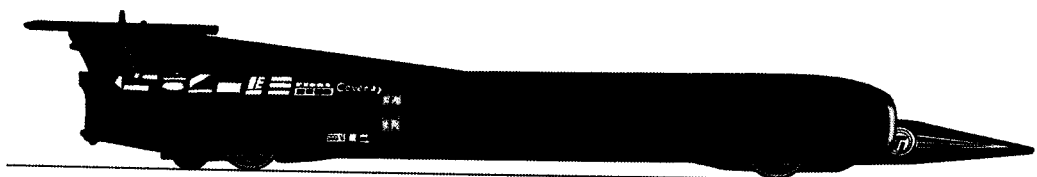
**same frequency (1)**

**any smaller amplitude (1)**

**2**

27. A vehicle called Thrust SSC broke the land speed record in 1997 in the Nevada Desert, USA.

Marks

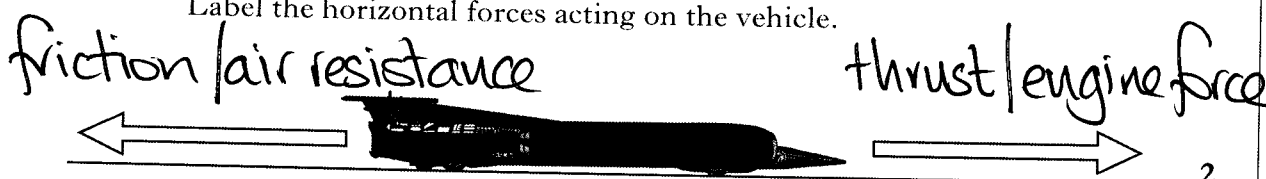


- (a) The mass of Thrust SSC is 10 500 kg.  
Calculate the weight of Thrust SSC.

$$\begin{aligned} W &= mg \\ W &= 10500 \times 9.8 \\ W &= 102900 \text{ N} \end{aligned}$$

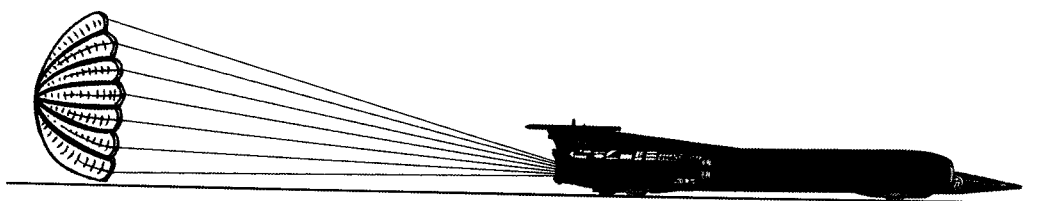
2

- (b) The diagram below shows Thrust SSC travelling at a constant speed.  
Label the horizontal forces acting on the vehicle.



2

- (c) At the end of the run, Thrust SSC uses a parachute as shown.



- (i) What effect does the parachute have on the motion of the vehicle?

the vehicle slows down  
(decelerates / stops)

1

- (ii) Explain your answer.

the parachute increases air resistance  
(friction)  
(or similar)

1

27. (continued)

Marks

- (d) On one run Thrust SSC travelled 1710 metres in 5.0 seconds.  
Calculate the average speed of Thrust SSC during this run.

$$\bar{v} = \frac{d}{t}$$
$$\bar{v} = \frac{1710}{5}$$
$$\bar{v} = 342 \text{ m/s.}$$

2

[Turn over]

## SECTION B

Marks

21. A satellite dish is used to detect TV signals.

(a) Complete the sentences below using some of these words.

lower  
200 million

higher  
stronger

340  
geostationary

300 million  
weaker

TV signals have a **higher ( $\frac{1}{2}$ )** frequency than radio signals.

TV signals travel at a speed of **300 million ( $\frac{1}{2}$ )** metres per second.

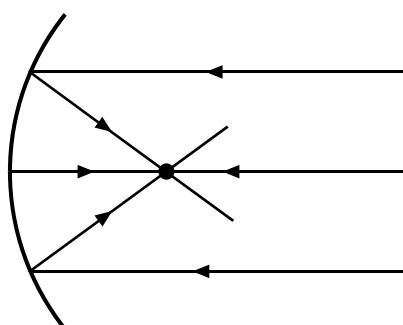
A satellite dish is curved to make the received signal **stronger ( $\frac{1}{2}$ )**.

A satellite that stays above the same point on the Earth's surface is called a

**geostationary ( $\frac{1}{2}$ )** satellite.

2

(b) Complete the diagram to show the effect the satellite dish has on the TV signals received.



2

(c) (i) If the curved dish is made larger, does the received signal strength **increase**, **decrease** or **stay the same**?

**increase**

1

(ii) Explain your answer.

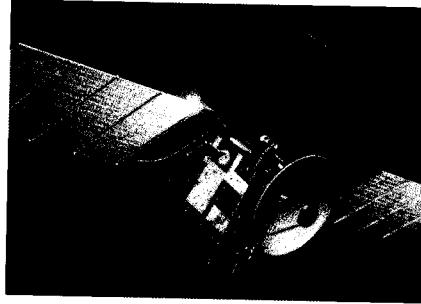
**more energy (or signals) collected**

1

Marks

30. An unmanned spacecraft is on a mission to Mars.

The engines of the spacecraft are turned off once it has travelled far into space.



- (a) The spacecraft now travels at a constant speed.  
Explain why this happens.

the forces are balanced

1

The table below gives some information on the planets.

Planet	Gravitational pull in newtons per kilogram
Earth	10
Mars	4
Jupiter	26
Saturn	11

- (b) The spacecraft has a mass of 900 kg.  
(i) What is the weight of the spacecraft on Earth?

$$W = mg \quad (\text{using value of 'g' in table})$$

$$W = 900 \times 10 = 9000 \text{ N}$$

2

- (ii) Complete the following sentence by **circling** the correct word or phrase.

The mass of the spacecraft on Mars is

the same as its mass on Earth.

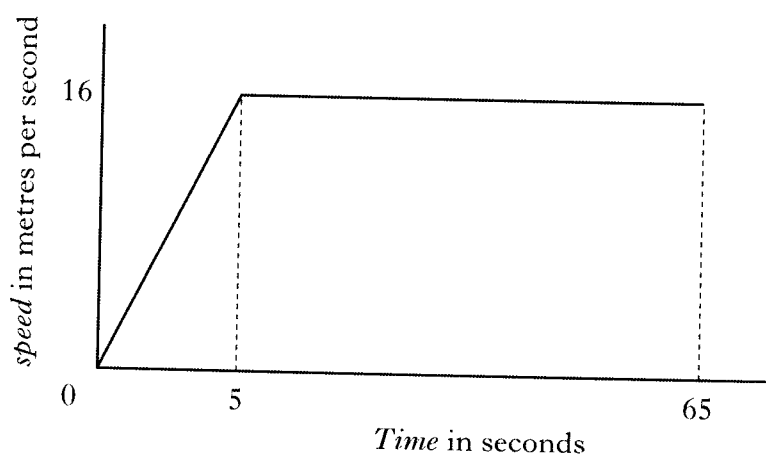
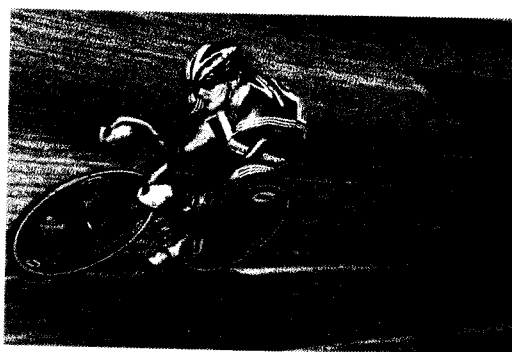
zero.

different from its mass on Earth.

1

32. The graph below shows the speed of a cyclist during a 1000 metre sprint race.

Marks



- (a) State the maximum speed of the cyclist during the race.

16 m/s

1

- (b) Calculate the average speed of the cyclist during the race.  
Give your answer to 2 decimal places.

$$\bar{v} = \frac{d}{t}$$

$$\bar{v} = \frac{1000^*}{65}$$

$$\bar{v} = 15.38 \text{ m/s}$$

\* do not need to  
calculate area  
under graph as  
distance given at  
start of question.

2

29. (a) A bungee jumper wants to calculate his average speed during a jump. On the first descent he falls 63 metres in 4.5 seconds.

Marks

- (i) What device can be used to measure the time of the descent?

stopwatch

1

- (ii) Calculate his average speed during the descent.

$$\bar{v} = \frac{d}{t}$$
$$\bar{v} = \frac{63}{4.5}$$
$$\bar{v} = 14 \text{ m/s}$$

2

- (b) During a second descent the bungee jumper wears baggy clothing and spreads his arms out as he falls.



He falls 63 metres in 5 seconds.

- (i) Why was the time greater for the second descent?

More air resistance

1

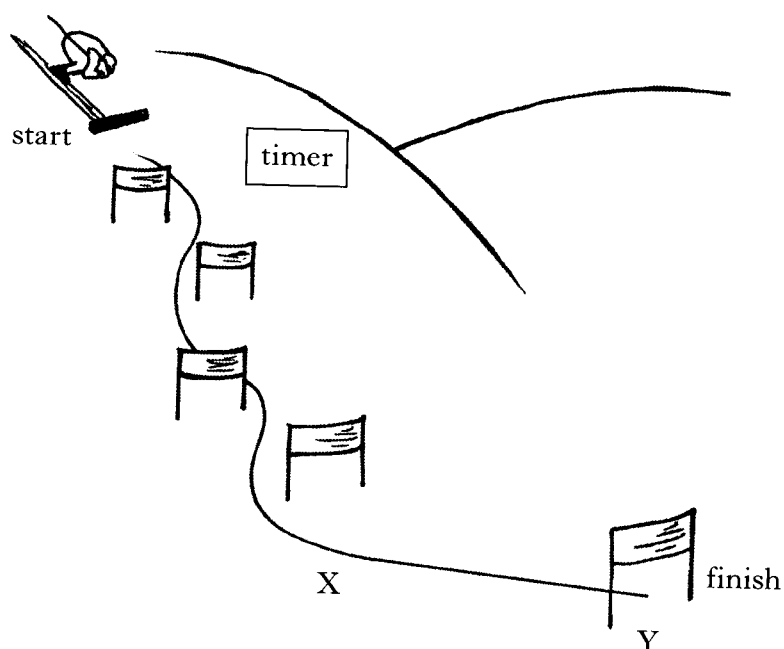
- (ii) The bungee jumper has a mass of 65 kg. Calculate his weight.

$$W = Mg$$
$$W = 65 \times 9.8$$
$$W = 637 \text{ N}$$

2

28. At the end of a week of skiing lessons, students are given a chance to try a short downhill course.

Marks



- (a) The students want to calculate the average speed of a skier down the course. An electronic timer is used to measure the time between the start and finish lines.

- (i) What electronic device could be used to stop the timer at the finish line?

light gate

1

- (ii) What other measurement is needed to calculate the average speed?

distance travelled.

1

- (iii) How would these measurements be used to calculate the average speed?

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

1

## 28. (continued)

Marks

- (b) (i) The mass of the skier is 60 kilograms.  
Calculate the weight of the skier.

$$\begin{aligned} W &= Mg \\ W &= 60 \times 9.8 \\ W &= 588\text{N} \end{aligned}$$

2

- (ii) Between points X and Y the forces on the skier are balanced.  
What happens to the speed of the skier between points X and Y?

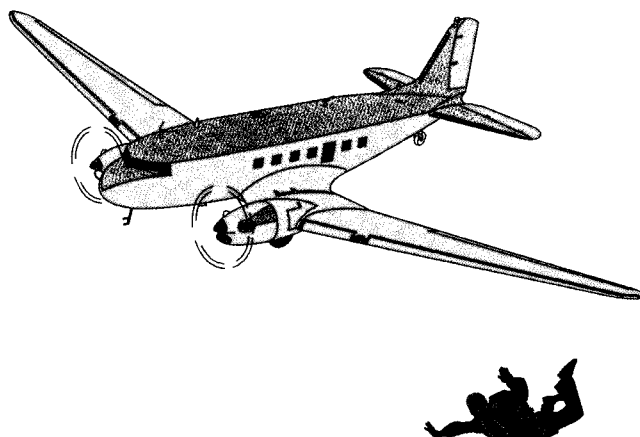
the speed remains constant.

1

[Turn over]

28. A skydiver jumps out of a plane.

Marks



- (a) The skydiver and her parachute have a total mass of 75 kilograms. Calculate the total weight of the skydiver and parachute.

$$\begin{aligned} W &= Mg \\ W &= 75 \times 9.8 \\ W &= 735 \text{ N} \end{aligned}$$

2

- (b) When she first leaves the plane, the skydiver accelerates towards the earth.

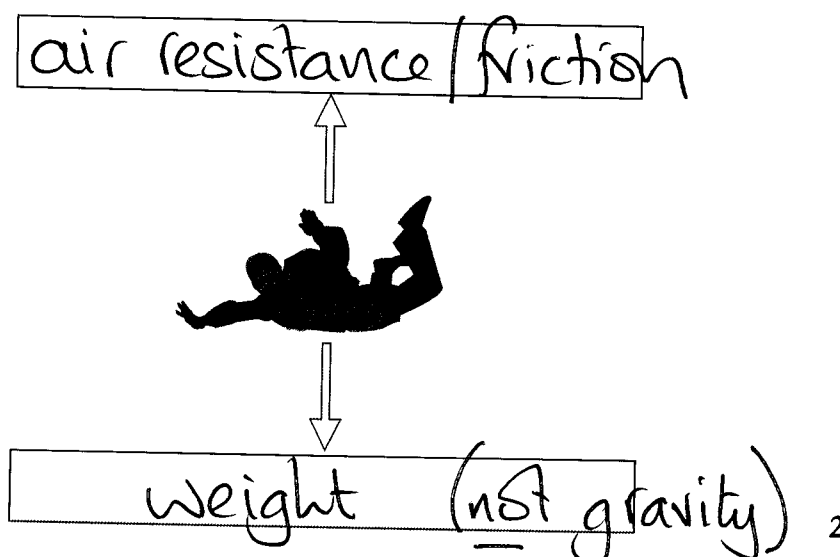
What does the term accelerate mean?

changing speed

1

- (c) The diagram below shows the skydiver and the forces acting on her.

- (i) Name the **two** vertical forces acting on the skydiver.



2

28. (c) (continued)

Marks

- (ii) Some time later these two forces become balanced.

When the forces are balanced, does her speed **increase**, **stay the same** or **decrease**?

stay the same

1

- (d) The skydiver then opens her parachute.



- (i) What happens to her speed at this moment?

speed decreases

1

- (ii) What happens to the upward force acting on her?

increases

1

[Turn over]

Marks

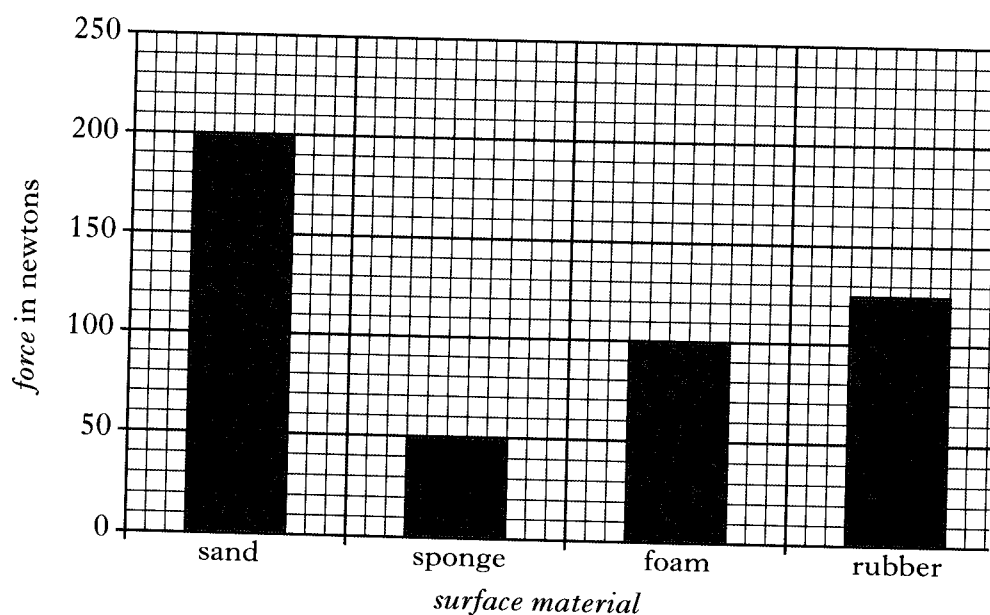
28. A pole vaulter wants to find out which material is best for making a landing surface. Four materials are tested in a lab.

A dummy body is dropped onto each surface in turn.

The maximum force exerted on the dummy by each surface is measured.

The dummy is dropped from the same height each time.

The graph shows the maximum force exerted by the different surfaces.



- (a) (i) Which material should be used for the landing surface?

sponge

1

- (ii) Explain your answer.

sponge has the smallest force

1

- (iii) Why is the height kept the same each time?

fair test / fair comparison

1

28. (continued)

Marks

(b) The experiment is repeated with a dummy of smaller mass.

- (i) Will the maximum force exerted on the dummy **increase**, **decrease** or **stay the same**?

decrease

1

- (ii) Explain your answer.

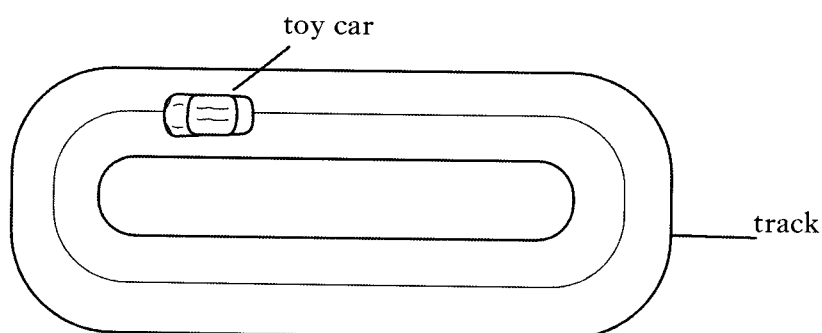
smaller mass gives a  
smaller weight force

1

[Turn over]

30. A toy car is timed going round a track. The car takes 8 seconds to cover 4 laps of the track. One lap of the track is a distance of 3 metres.

Marks



- (a) Calculate the average speed of the car on the track.

$$\begin{aligned} 4 \text{ laps} &= 4 \times 3 \text{ m} = 12 \text{ m} \\ \bar{v} &= \frac{d}{t} \\ \bar{v} &= \frac{12}{8} \quad \bar{v} = 1.5 \text{ m/s} \end{aligned}$$

3

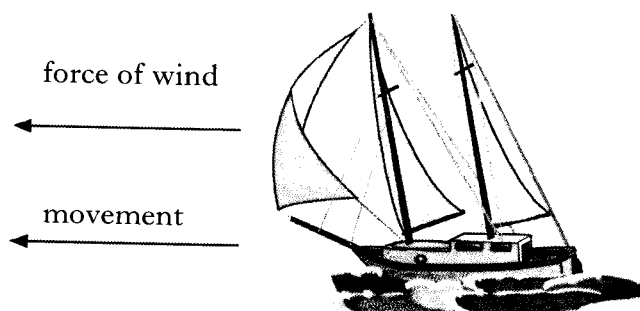
- (b) The original car is replaced by a more streamlined one. Explain the term **streamlined**.

the car's shape produces less air resistance.  
or the car has a smoother shape

1

31. Wind exerts a forward force on a yacht causing it to move in the direction shown.

Marks



- (a) There is another force on the yacht acting in the opposite direction to the direction of movement. Name this force.

friction

1

- (b) The yacht must be lifted out of the water for repairs.

A machine for lifting yachts can exert a maximum upwards force of 14 000 newtons. The yacht has a mass of 1500 kilograms.

- (i) Calculate the weight of the yacht.

$$W = Mg$$

$$W = 1500 \times 9.8$$

$$W = 14700N$$

2

- (ii) Will the machine be able to lift the yacht out of the water?

no

1

- (iii) Explain your answer.

the lifting force is smaller than the weight of the yacht.

1

Marks

28. A car manufacturer is carrying out safety tests on a new model of car.

During one test run an empty car collides with a wall.

The damage to the car is assessed by measuring how much the length of the front of the car has changed during the collision.



The test is carried out with identical cars at two different speeds, 10 metres per second and 20 metres per second.

- (a) Which speed causes the biggest change in length of the front of the car?

20 m/s

1

- (b) (i) The wall exerts a force on the car to make it stop.  
Is this a balanced or an unbalanced force?

unbalanced

1

- (ii) Explain your answer.

change in speed is caused  
by unbalanced forces

1

## 28. (continued)

Marks

- (c) The car manufacturer compares the new car's performance to an older model.

<i>Model</i>	<i>Mass</i> (kilograms)	<i>Time to accelerate from 0 to 60</i> <i>miles per hour (seconds)</i>
New	850	12.3
Old	850	11.6

- (i) Which model has the larger acceleration?

old model

1

- (ii) Which car's engine exerts a bigger force when accelerating from 0 to 60 miles per hour?

old model

1

- (iii) How could the body of the new model be changed to improve the acceleration?

reduce its mass  
or  
Make the new model  
more streamlined.

1

[Turn over]