01. The pressure p and the density p of a gas are related by the expression

$$C = \sqrt{\frac{yp}{P}}$$

Where c and y are constants.

(i) 1. Find the base units of density p.

2. Show that $kgm^{-1}\ s^{-2}$ are the base units of pressure p.

(ii) Find the unit of c, given that y has no unit.

(ii) Suggest, using your answer to (ii), what is the quantity represented by the symbol c.

02. Measurements are taken by a student to determine the acceleration of free fall. The time t for a small metal ball to fall from rest through a vertical distance h is measured, and the data are;

h = 266 $\pm$ 1cm t = 0.740 $\pm$ 0.005cm

(a) Calculate , using these data,

(i) A value of the acceleration of free fall g , to three significant figures,

(ii) The percentage uncertainty , to two significant figures , of

1. The distance h, 2. The time t.

(b) Determine, using your answers in (a), the actual uncertainty in the value of g. Hence state the value of g, to an appropriate number of significant figures, with its uncertainty.

(c) In this experiments, although the value of t is precise, it may not be accurate. Suggest two reasons why.

03. Fig. 3.1 is a Graph showing the variation of velocity v of an athlete with time t during a 100m race.

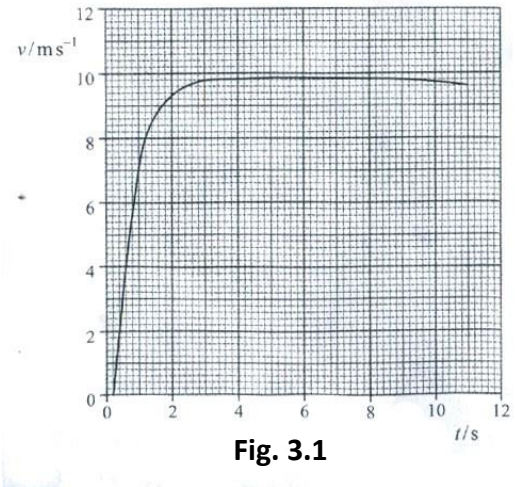

Fig. 3.1

The race may be taken to starts at time t = 0.

(a) The athlete`s velocity takes a short time to increase above zero.

(i) Deduce a value for this time from the graph.

(ii) Suggest a reasons for this delay.

(b) By referring to the graph , deduce

(i) The athlete`s maximum velocity,

(ii) The athlete`s maximum acceleration,

(iii) The distance travelled by the athlete between the times t = 4.0s and t = 8.0s

(c) Given that 10 people with stop watches are available, outline an experimental procedure to obtain such a graph.

(d) Sketch the corresponding acceleration – time graph.

(e) The men`s Olympic record for 200m is less than twice the time for 100m. Suggest why.

04. Fig 4.1 illustrates how a stuntman plants to ride a motorcycle up a ramp in order to jump over a number of cars. Just as it leaves the ramp, the speed of the motorcycle is $14ms^{-1}$. Air resistance may be taken to be negligible.

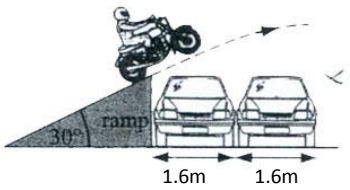

Fig. 4.1

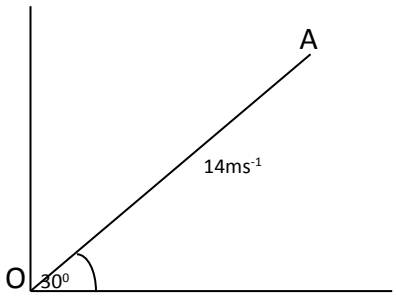

Fig.4.2

(a) The line OA on fig 4.2 represents the initial velocity of the motorcycle just as it leaves the ramp.

(i) Why does OA represents the velocity of the motorcycle and not just its speed?

(ii) Write down the scale used in fig 4.2

(iii) construct lines on fig 4.2 to represent the horizontal and the vertical components of the initial velocity of the motorcycle. Find

1. The horizontal components of the velocity,
2. The vertical component of the velocity

(b) Find the time interval between the motorcycle leaving the end of the ramp reaching the maximum height.

(c) Given that the cars are each of width 1.6m and have the same height as the ramp, estimate the maximum number of cars which the motorcyclist can jump for the take off speed of 14 ms^{-1}

05.

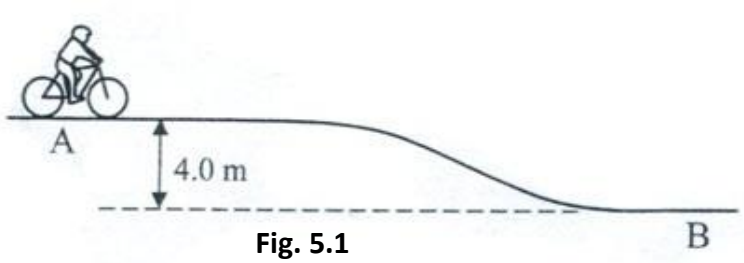

Fig. 5.1

(a) Fig 5.1 shows a cyclist initially moving with a constant speed of 15ms^{-1} On a flat road at A. He then descends 4.0m down a small slope to B. The cyclist and bicycle have a combined mass of 90kg. Determine

(i) The kinetic energy at A,

(ii) The loss of potential energy between A and B,

(iii) The speed at B, Assuming that all the lost potential energy is transformed into kinetic energy of the cyclist and bicycle.

(b) (i) A cyclist provides a power of 240W when travelling at a constant speed of 15ms-1 on a level road. Find the total resistive force.

(ii) Explain why the cyclist needs to provide a greater power when travelling at a higher constant speed.

(c) Many forms of transport are described as transforming chemical Energy into kinetic energy .why is a cyclist travelling at constant speed Not making this transformation?
Describe the transformations energy that are taking place

06. A diffraction grating, with 4.00×10^5 lines per metre, has a narrow beam of Coherent light of wavelength 589 nm incident normally on it.

(i) Find the number of order of diffracted light that are visible on each Side of the zero order.

(ii) The incident beam is suspected to consist of two wavelengths of light, one at 589.0 nm and the other at 589.6 nm.

1. What is the order of diffracted light at which the two wavelengths are most likely to be distinguished?

2. Given that the minimum angular separation of the diffracted light for which two wavelengths may be distinguished is 0.10^0 , calculate to determine whether the two wavelengths could be observed as separate images.

07. The filament of a household electric lamp is a wire of constant radius 6.0×10^{-6} m made from tungsten. At the normal operating temperature of the lamp, the resistivity of tungsten is $7.9 \times 10^{-7}\Omega$m.The lamp is marked 240 V 60 W.

(a) For the lamp at its normal operating temperature,

(i) Find the current in the lamp,

(ii) Show that the filament`s resistance is 960Ω

(b) Determine the length of the filament.

(c) What could be deduced from your answer to (b)?

(d) Why is it difficult to quote a value for the resistance of a filament lamp?

08. The radioactive decay of nuclei is described as both spontaneous and random.

(a) Radioactive decay of a nucleus, (b) spontaneous decay

(c) Random decay?