01.(i) 1. Density $p = \frac{\text{mass}}{\text{Volume}}$

Base units of p

$= \frac{\text{base units of mass}}{\text{Base units of volume}}$

$= \frac{kg}{m^2} \quad = kgm^{-3}$

2. Pressure $p = \frac{\text{force}}{\text{Area}}$

$Kgms^{-2} \quad = kgm^{-1} s^{-2}$

(ii) $c = \sqrt{\frac{yp}{p}}$

Base units of c

$= \sqrt{\frac{(\text{base units of } y)\text{base units of } p)}{\text{base units of of } p}}$

=

(iii) Since the base units [ms^{-1}] are those of speed, the symbol c may be representing the speed or velocity of sound in gases

02. (a)

(i) $h = 0 + \frac{1}{2}gt^2$

In the usual notations acceleration of free fall

$g = \frac{2h}{t2} = \frac{2(266 \times 10-2}{(0.740)2}$

$= 9.175 = 9.72ms^{-2}$

(ii)

1. Percentage uncertainty in the distance h,

$\frac{\Delta h}{h} = \frac{1}{266} = 0.00376$

$= \quad 0.00376 \times 100\% = 0.38\ \%$

2. Percentage uncertainty in time t,

$\frac{\Delta t}{t} = \frac{0.005}{0.740} = 0.00676$

0.00676 × 100% = 0.01728

(b) $g = \frac{2h}{t^2}$

$\frac{\Delta g}{g} = \frac{\Delta h}{h} + 2\frac{\Delta t}{t}$

= (0.00376) + 2 (0.00676) = 0.0178

∴ Uncertainty in a g,

Δg = 0.01728 g = 0.01728(9.715)

= 0.168 = 0.2

$g = 9.7 \pm 0.2 ms^{-2}$

(c) Reasons why value of t may not be accurate:

1. The timing device has a zero error.
2. The student persistently mis – timed starting and / or stopping of the timing device.

03. (a)

(i) From given graph, delay = 0.2 s

(ii) the delay could be the reaction time of the athlete.

(b)

(i) Maximum velocity of athlete,

$v_{max} = 9.9(\pm 0.1)\ ms^{-1}$

(ii) Athletes maximum acceleration,

a = maximum gradient of graph

≈ Gradient between t = 0.2 and t = 0.6

= (4.0 – 0)/(0.6 – 0.2) = $10ms^{-2}$

(iii) distance travelled between t = 4.0 and t = 8.0 s = area of under graph form t = 4.0 to t = 8.0,

Average speed of athlete form t = 4.0 to t = 8.0,

$v_{avg} \approx 9.85ms^{-1}$

∴ s = (9.85)(8.0 – 4.0)

= 39.4 = 39m

(c) The 10 people could be placed at measured intervals along the track. When the race starts, all the stop watches are started. Every person will stop his stop watch when the athlete is level with him.

A distance – time graph could be plotted from the collected data. By measuring the gradient of the tangent to distance – time graph at different times, the velocity – time graph could be plotted.

(d) Sketch acceleration – time graph:

(e) For a 200 m run , the reaction – time delay and acceleration are similar to that in a100m run, but the high speed is maintained over a longer duration. Thus the average speed will be higher and the running time will be less than twice that for 100m.

04. (a)

(i) The directed line OA represents the velocity and not just speed because it specify both magnitude and direction

(ii) OA = 7.0cm

1cm $\frac{14}{7.0}$ =2.0ms^{-1}

(iii) line OH and OV representing horizontal and vertical components of velocity respectively

1. Horizontal component of velocity,

u_H= (14)cos 30^0 = 7.0ms^{-1}

2. $v = ut + at$

$\equiv u_v - gt$ for vertical direction

At maximum height, $v = o$

(0) = (7.0) – (9.81)t

∴ time reach maximum height ,

T = 0.7136 = 0.71s

05. (a)

(i) KE at A,

E_{kA} = $\frac{1}{2}$ mv^2 in the usual notations

= $\frac{1}{2}$ (90)(15)^2

= 10125 = 10kJ

(ii) Loss of PE between A and B

ΔE_p = mgh

= (90) (9.81) (4.0)

=3531.6 =3.5kJ

(iii) Let v_B = speed at B

Gain in KE = lass of PE

i.e. $\frac{1}{2}mv_B{}^2$ -E_A = ΔE_p

$\frac{1}{2}(90)v_B{}^2 - (10125) = (3531.6)$

$v_B{}^2 = 303.48$

∴ v_B = 17.4 = 17ms^{-1}

(b)

(i) Let R = total resistive force

P = Fv in the usual notations

Bicycle at constant speed of v = 15ms^{-1}

R = F =P/v = (240)/(15) =16N

(ii) With F = P/v, at a higher constant speed v, a greater power P would be needed to produce the same force F needed to overcome the same total resistive force R,

In addition, resistive forces are usually a function of speed. At higher (constant) speeds, the total resistive force R would also be geater.hence, a greater power would also be needed to produce a greater F to overcome the the greater total resistive force R.

(c) a cyclist travelling at constant speed has constant kinetic energy, and is therefore not transforming any form of energy into kinetic energy.

How ever, in order to maintain the speed, the cyclist has overcome various resistive forces. The energy required are transformed from the chemical energy stored in the cyclist`s muscles. Most of the chemical energy are transformed into heat in, e.g., the tyres, the road, the gears and the surrounding air, and some may be transformed into sound.

06. (i) nλ = d sin θ_n in the usual notations

Sin $\theta_n \leq$ and n = $\frac{d}{\lambda}$ sin θ_n

$n \leq \frac{d}{y} = \frac{1/(4.00 \times 10^{5)}}{589 \times 10^{-9}}$ = 4.24

∴ No. Of orders visible = 4

(ii)

1. The order at which the 2 wavelengths are most likely to be distinguished = highest visible order = 4

2. θ_n = sin $^{-1}\frac{(4)(589 \times 10^{-9})}{1/(4.00 \times 10^5}$ = 70.46^0

For λ = 589.6nm,

θ_4 = sin $^{-1}\frac{(4)(589.6 \times 10^{-9})}{1/(4.00 \times 10^5)}$

The difference,

$\Delta\theta$ = 70.62 – 70.46 = $0.16^0 > 0.10^0$

The student can observe the 2 wavelengths as separate images.

07. (a)

(i) P =VI

I =P/V = (60) /(240) = 0.25A

(ii) V =IR

R =V/I =(240)/(0.25) =960Ω

(b) R = $p\ l$ /A

$l =$ RA / p = (960)[$\pi(6.0 \times 10^{-6})^2$]/($7.9 \times 10^{-7}$)

= 0.1374 = 0.137m

(c) The length of 0.137m is long relative to the size of a typical lamp and so the filaments must be coiled.

(d) it is difficult to quote a value for the resistance of a filament lamp because its resistance varies with its temperature.

08. (a) Radioactive decay is the spontaneous and random disintegration of an unstable nucleus into a more stable configuration by emitting $\alpha - \beta -$ And / or γ- radiations, with slight or no change in the mass of the nucleus.

(b) The spontaneous nature refers to the process being unaffected by environmental/ external conditions,e.g temperature and pressure.

(c) The random nature refers to the process being unpredictable /variable without any pattern or trend. It is not possible to predict which nucleus will decay next.