Solving calculation problems

Question 1 Match the quantity with the unit

Quantity	Unit
a) force	1) ms^{-2}
b) momentum	2) kg
c) distance	3) $kgms^{-1}$
d) time	4) m
e) Velocity	5) N
f) mass	6) s
g) acceleration	7) ms^{-1}

Question 2 Change these numbers into SI units

98 MN _____

45 cm _____

3 minutes _____

20 g _____

93 km _____

14 µm _____

23 km hr^{-1} _____

Question 3 Rearrange these equations

a) $E_p = mgh$ rearrange to find height
b) $F = kx$ rearrange to find spring constant k
c) $v_f^2 = v_i^2 + 2ad$ rearrange to find distance
d) $E_K = \frac{1}{2}mv^2$ rearrange to find velocity
e) $F_g = G\frac{m_1 m_2}{r^2}$ rearrange to find radius
f) $v_f = v_i + at$ rearrange to find time

Use the equations given in question 3 to answer questions 4 – 8

Question 4

A car travels at 30 ms^{-1} and then decelerates to 8 ms^{-1} in 5 seconds. Calculate the deceleration of the car.

Question 5

How much time does it take an object to change velocity from 20 ms^{-1} to 5 ms^{-1} if the object's acceleration is -3 ms^{-2}?

Question 6

A 12 kg object gains 3450 J of gravitational potential energy. What height did the object reach? (Assume gravity has a value of 10 ms^{-2})

Question 7

A 16 kg object gains 1250 J of gravitational potential energy. What velocity did the object reach?

Question 8

A spring has a force of 400N placed on it and it extends 8 cm. Find the spring constant of the spring.

Answers

Question 1 Match the quantity with the unit

Quantity	Unit
a) force	5) N
b) momentum	3) $kgms^{-1}$
c) distance	4) m
d) time	6) s
e) Velocity	7)ms^{-1}
f) mass	2) kg
g) acceleration	1)ms^{-2}

Question 2 Change these numbers into SI units

98 MN ⟶ 98×10^{6} N

45 cm ⟶ 45×10^{-2} m

3 minutes ⟶ $3 \times 60 = 180$ s

20 g ⟶ 20×10^{-3} kg

93 km ⟶ 93×10^{3} m

14 μm ⟶ 14×10^{-6} m

23 km hr^{-1} ⟶ $\frac{23 \times 10^{3} m}{60 \times 60} = 6.4 ms^{-1}$ *or* $\frac{kmhr^{-1}}{3.6} = ms^{-1}$

Question 3

Rearrange these equations

a) $E_p = mgh$ the mg needs to be moved so that the h (height) is alone – so it is the subject.

Divide the E_p by mg to get h $\frac{E_p}{mg} = h$

b) $F = kx$ the x (extension or change in length) needs to be moved so that the k (spring constant) is alone – so it is the subject. Divide the F by x to get k $\frac{F}{x} = k$

c) $v_f^2 = v_i^2 + 2ad$ The 2a (2 x acceleration) needs to be moved. 2ad means 2xaxd so you need to divide by 2a. And the v_i^2 needs to be subtracted from the v_f^2 $\frac{v_f^2 - v_i^2}{2a} = d$

d) $E_K = \frac{1}{2}mv^2$ The $\frac{1}{2}m$ $\left(\frac{1}{2}x\ mass\right)$ needs to be moved. $\frac{1}{2}mv^2$ means $\frac{1}{2}\ x\ mass\ x\ velocity^2$ so you need to divide E_K by $\frac{1}{2}m$ .And then you need to square root both sides so you get v not v^2 $\sqrt{\frac{E_K}{\frac{1}{2}m}} = v$

e) $F_g = G\frac{m_1 m_2}{r^2}$ In this case you can swap the F_g and the r^2 . And then you need to square root both sides so you get r not r^2 $r = \sqrt{G\frac{m_1 m_2}{F_g}}$

f) $v_f = v_i + at$ The a (acceleration) needs to be moved. at means axt so you need to divide by a. And the v_i needs to be subtracted from the v_f $\frac{v_f - v_i}{a} = t$

Question 4

Information given $v_i = 30ms^{-1}$ $v_f = 8ms^{-1}$ $t = 5s$ *Quantity required : looking for acceleration*

$$v_f = v_i + at \quad \frac{v_f - v_i}{t} = a = \frac{30-8}{5} = -4.4ms^{-2}$$

Question 5

Information given $v_i = 20ms^{-1}$ $v_f = 5ms^{-1}$ $a = -3ms^{-2}$ *Quantity required : looking for time*

$$v_f = v_i + at \quad \frac{v_f - v_i}{a} = t = \frac{5-20}{-3} = 5\ s$$

Question 6

Information given $m = 12kg$ $E = 3450J$ $g = 10ms^{-2}$ *Quantity required :* looking for height

$$E_p = mgh \quad \frac{E_p}{mg} = h = \frac{3450}{12x10} = 28.75m$$

Question 7

Information given $m = 16kg$ $E = 1250J$ *Quantity required :* looking for velocity

$$E_K = \frac{1}{2}mv^2 \quad \sqrt{\frac{1250}{\frac{1}{2}x16}} = 12.5ms^{-1}$$

Question 8

Information given $F = 400\ N$ $x = 8x10^{-2}m$ *Quantity required :* looking for spring constant

$$F = kx \quad \frac{F}{x} = k = \frac{400}{8x10^{-2}} = 5000Nm^{-1}$$