

PHYSICS

PAPER 2 2020 — 2025

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1 - (9702/21_Summer_2020_Q1)



- (a) Use an expression for work done, in terms of force, to show that the SI base units of energy are $\text{kg m}^2 \text{s}^{-2}$.

[2]

- (b) (i) The energy E stored in an electrical component is given by

$$E = \frac{Q^2}{2C}$$

where Q is charge and C is a constant.

Use this equation and the information in (a) to determine the SI base units of C .

SI base units [2]

- (ii) Measurements of a constant current in a wire are taken using an analogue ammeter.

For these measurements, describe one possible cause of:

- 1. a random error

.....
.....

- 2. a systematic error.

.....
.....

[2]

[Total: 6]

2 - (9702/22_Summer_2020_Q1)



(a) Define *velocity*.

.....
..... [1]

(b) The drag force F_D acting on a car moving with speed v along a straight horizontal road is given by

$$F_D = v^2Ak$$

where k is a constant and A is the cross-sectional area of the car.

Determine the SI base units of k .

SI base units [2]

(c) The value of k , in SI base units, for the car in (b) is 0.24. The cross-sectional area A of the car is 5.1 m^2 .

The car is travelling with a constant speed along a straight road and the output power of the engine is $4.8 \times 10^4 \text{ W}$. Assume that the output power of the engine is equal to the rate at which the drag force F_D is doing work against the car.

Determine the speed of the car.

speed = ms^{-1} [3]

[Total: 6]

3 - (9702/23_Summer_2020_Q1)



(a) State **one** similarity and **one** difference between *distance* and *displacement*.

similarity:

.....

difference:

.....

[2]

(b) A student takes several measurements of the same quantity. This set of measurements has high precision, but low accuracy.

Describe what is meant by:

(i) *high precision*

.....

..... [1]

(ii) *low accuracy*.

.....

..... [1]

[Total: 4]

4 - (9702/22_Winter_2020_Q1) **ANSWER**

- (a) Complete Table 1.1 by putting a tick (✓) in the appropriate column to indicate whether the listed quantities are scalars or vectors.

Table 1.1

quantity	scalar	vector
acceleration		
density		
temperature		
momentum		

[2]

- (b) A toy train moves along a straight section of track. Fig. 1.1 shows the variation with time t of the distance d moved by the train.

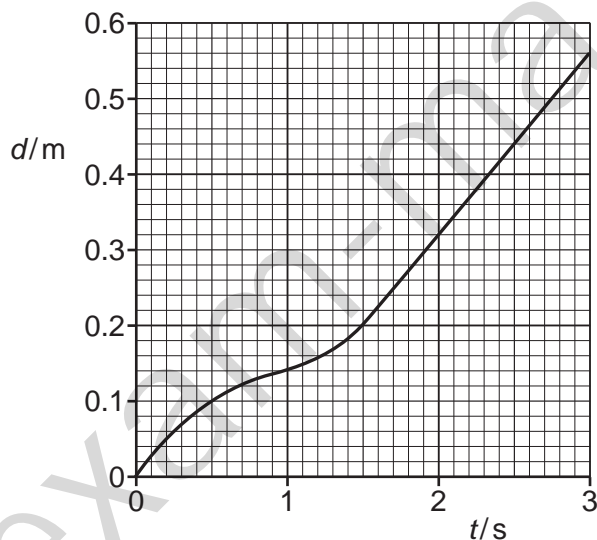


Fig. 1.1

- (i) Describe qualitatively the motion of the train between time $t = 0$ and time $t = 1.0$ s.

.....
 [1]

(ii) Determine the speed of the train at time $t = 2.0\text{ s}$.

speed = ms^{-1} [2]

(c) The straight section of track in (b) is part of the loop of track shown in Fig. 1.2.

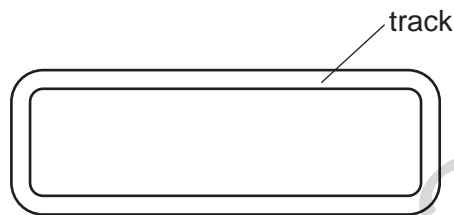


Fig. 1.2

The train completes exactly one lap of the loop.

State and explain the average velocity of the train over the one complete lap.

.....
.....
..... [1]

[Total: 6]

5 - (9702/23_Winter_2020_Q1)



(a) An electromagnetic wave has a wavelength of $85\ \mu\text{m}$.

(i) State the wavelength, in m, of the wave.

wavelength = m [1]

(ii) Calculate the frequency, in THz, of the wave.

frequency = THz [2]

(iii) State the name of the region of the electromagnetic spectrum that contains this wave.

..... [1]

(b) The current I in a coil of wire produces a magnetic field. The energy E stored in the magnetic field is given by

$$E = \frac{I^2 L}{2}$$

where L is a constant.

The manufacturer of the coil states that the value of L , in SI base units, is $7.5 \times 10^{-6} \pm 5\%$.
The current I in the coil is measured as $(0.50 \pm 0.02)\ \text{A}$.

The values of L and I are used to calculate E .

Determine the percentage uncertainty in the value of E .

percentage uncertainty = % [2]

[Total: 6]

1 - (9702/21_Summer_2020_Q1)



(a)	(work =) force \times displacement	C1
	units: $\text{kg m s}^{-2} \times \text{m} = \text{kg m}^2 \text{s}^{-2}$	A1
(b)(i)	units of Q : As	C1
	units of C : $\text{kg}^{-1} \text{m}^{-2} \text{A}^2 \text{s}^4$	A1
(b)(ii)	1. e.g. reading scale from different angles (wrongly) interpolating between scale readings/divisions	B1
	2. e.g. zero error wrongly calibrated scale	B1

2 - (9702/22_Summer_2020_Q1)



(a)	(velocity =) change in displacement / time (taken)	B1
(b)	units of F : kg m s^{-2}	C1
	units of k : $\text{kg m s}^{-2} / [\text{m}^2 \times (\text{m s}^{-1})^2]$ $= \text{kg m}^{-3}$	A1
(c)	$P = Fv$	C1
	$4.8 \times 10^4 = 0.24 \times 5.1 \times v^3$	C1
	$v = 34 \text{ m s}^{-1}$	A1

3 - (9702/23_Summer_2020_Q1)



(a)	similarity: both have magnitude	B1
	difference: distance is a scalar/does not have direction or displacement is a vector/has direction	B1
(b)(i)	the measurements have a small range	B1
(b)(ii)	the (average of the) measurements is not close to the true value	B1

4 - (9702/22_Winter_2020_Q1)



(a)	density and temperature indicated as scalars	B1
	acceleration and momentum indicated as vectors	B1
(b)(i)	decelerates or speed/velocity decreases	B1
(b)(ii)	speed = $(\Delta)d / (\Delta)t$ or gradient	C1
	= e.g. $(0.56 - 0.20) / 1.5$ = 0.24 m s^{-1}	A1
(c)	displacement is zero (so) average velocity is zero	B1

5 - (9702/23_Winter_2020_Q1)



(a)(i)	wavelength = 8.5×10^{-5} m	A1
(a)(ii)	$f = v/\lambda$ or c/λ	C1
	$= 3.0 \times 10^8 / 8.5 \times 10^{-5}$ ($= 3.5 \times 10^{12}$) $= 3.5$ THz	A1
(a)(iii)	infrared	B1
(b)	(implied) percentage uncertainty in $I = 4\%$ or (implied) fractional uncertainty in $I = 0.04$	C1
	percentage uncertainty in $E = 5\% + (4\% \times 2)$ $= 13\%$	A1