Carefully mark your answers. Be honest with yourself. If you did not understand the question check through your notes. Roughly each point you make is worth either 1 mark. If you need help ask your teacher, remember we are in this together!

Mrs Hargreaves

UNITS AND PREFIXES REVIEW ANSWERS

1. a) metre

   b) kilogram

   c) metres per second squared

   d) metres per second

   e) coloumb

2. This question is checking your ability to stick to a significant number of figures.

The acceleration is $\underline{0.3\ ms^{-2}}$.

You must not write any more than one sig. fig. as this is the level of accuracy given in the question.

$$F = ma$$
$$1 = 3a$$
$$a = \frac{1}{3}$$
$$a = 0.3$$

3. This question is checking that you are aware of prefixes used in Physics.

m = 0.1g = 0.1×10^{-3} kg

W=mg

$W=0.1\times10^{-3}\times9.8 = 9.8\times10^{-4}N$

$F=9.48\times10^{-4}N$

$W=9.8\times10^{-4}N$

Unbalanced force = ΔF, $F=0.32\times10^{-4}N$

$F=ma$

$0.32\times10^{-4} = 0.1\times10^{-3}a$

$\underline{a=0.32ms^{-2}}$

4. a) 5.0×10^{-3} A

b) 3.0×10^{-5} F

c) 2.00×10^{2} s

d) 4.5×10^{-5} F

UNCERTAINTIES REVIEW ANSWERS

1. ½ scale division÷reading × 100%

5/37 × 100% =13.5%

2. a) Fluff on a wheel, wind, door opening during an experiment etc.

   b) Zero errors on equipment, bad design (give egs) etc.

3. mean $=\Sigma x \div n$

   1.58+1.55+1.59+1.56+1.56+1.58= 9.42

   mean average =1.57s

   approx. random error = (max-min)) no. of readings

   = (1.59-1.55))6 =(0.04))6 =0.0067

   ΔR= 0.007s

   % uncertainty = $\Delta R \div$ mean $\times 100\%$

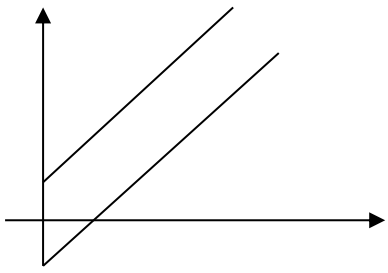
   % uncertainty= $0.0067 \div 1.57 \times 100\%$ = 0.42%

4. You must be aware that any experiment is liable to error, just look for them!

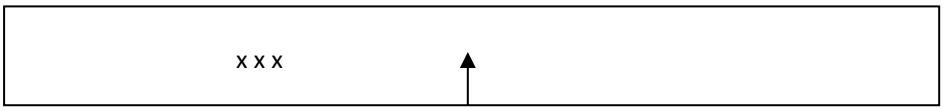
5. You can reduce your uncertainty by taking many readings, **but this will not help improve the accuracy if you have a systematic error**.

6. The best measurement that we can hope for is that the mean value is close to the "true" value.

7. Where you expect a graph to be a straight line through the origin, it might be a straight line with all the points close to a straight line but not going through the origin. The intercept can give us an indication of the systematic uncertainty.



or If the arrow represents the true value the x represent your readings.



8. a) (0.01/0.12)× 100% = 8.3%

b) (0.1/1.0)× 100% = 10%

9. mean =Σx/n

0.97+0.92+1.07+1= 3.96

mean average =0.99 ms^{-1}

approx. random error = (max-min)) no. of readings

= (1.07-0.92)/4 =(0.15)/4 =0.0375

% uncertainty = ΔR÷ mean ×100%

$$\%\ uncertainty = 0.0375 \div 0.99 \times 100\% = 4\%$$

Uncertainties are best given to one sig fig. Only round at the end.

However, as one of the results is recorded only to one sig fig this level of accuracy ought to be used throughout.

b) The error made was that as one of the answers was 1.00 this was wrongly recorded as 1.

10. Find the largest percentage error in the measurements

0.01/1.00×100% = 1.0%

0.02/0.16×100% = 12.5%

The uncertainty in the speed calculation will be 12.5%

speed = distance/time

= 1.00/0.16

= 6.25 ms^{-1}

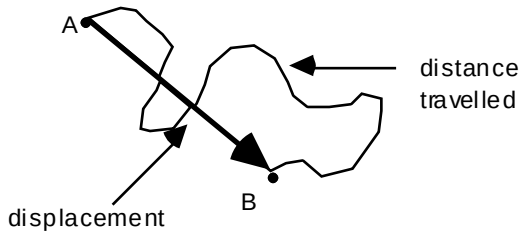
Speed = 6.25 $ms^{-1} \pm$ 12.5%

or

Speed = 6.25$\pm$0.78 ms^{-1} (where 0.78 is 12.5% of 6.25)

SCALAR AND VECTOR REVIEW ANSWERS

1.



Don't forget the angle!

2. The average speed is calculated by dividing the total distance from the kennel to the gate and back, by the time the dog took.

   Its average velocity is zero since its displacement is zero and

$$average\ velocity = \frac{displacement}{time}$$

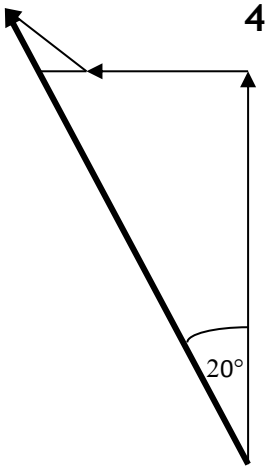
3. a) A vector quantity has both a size and a direction

   b) *Energy* is a scalar quantity, while *force* is a vector quantity. (check the rest from your notes and no cheating!)

   c) **A** is a vector quantity since both its size and direction are measured.

B is a scalar since it has size only, and so is **C** even though the size required happens to be an angle.

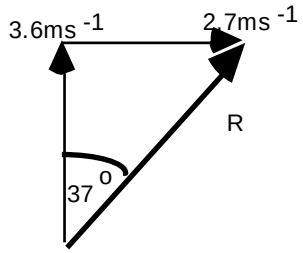
4.



The resultant velocity of the sick is
13.8 ms^{-1} , 14ms^{-1} @ 20^o W of N.

Do not use too many sig fig and be accurate in your drawings.

5.



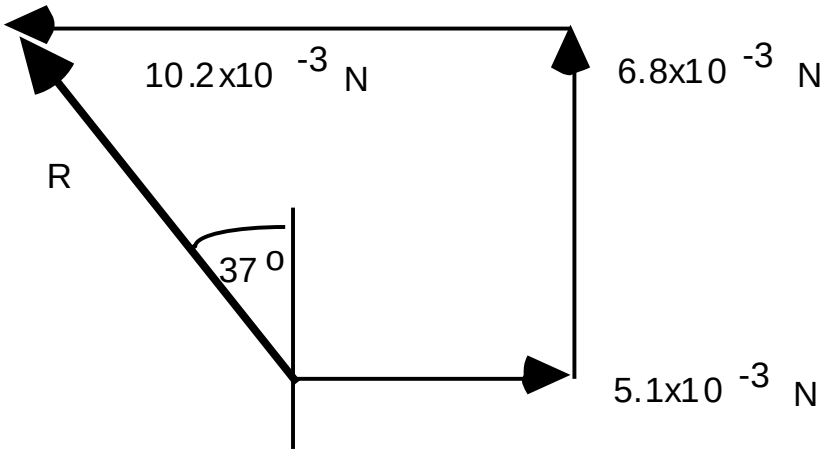
The resultant is 4.5ms^{-1} at 37^o east of north.

6. It is the single force that has the same effect as the several forces actually acting on the object.

7. x = 25cos30 = 21.65 units

y = 25sin30 = 12.5 units

8.



The resultant force is $9x10^{-3}$N at an angle of 36.9º west of north.

ACCELERATION REVIEW ANSWERS

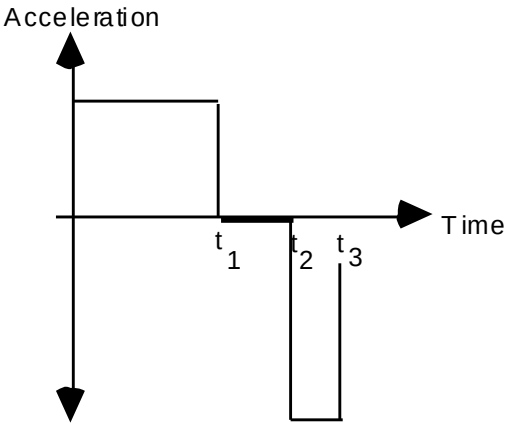
1. We need initial and final velocities, and the time between these two measurements.

   To get both velocity measurements requires measurements of the corresponding displacements and the times taken for these. This is usually done by attaching a card to the vehicle being used and using its length as the displacement. While it blocks a beam of light it operates an electronic clock which supplies the time taken for this displacement.

$$velocity = \frac{displacement}{time}, \qquad acceleration = \frac{velocity\ change}{time}$$

2. Acceleration is the rate of change of velocity.

3.



4. a) The acceleration is constant at some positive value between zero and t_1. Between t_1 and t_2 the acceleration remains at zero. Between t_2 and t_3 the acceleration is negative and of a higher value than the initial acceleration hence it is further below the time axis than the initial acceleration is above it.

   b) Constant acceleration: the velocity is increasing steadily by $7{\cdot}0\ ms^{-1}$ every 0.1s

5. a) From the definition of acceleration as

$$a = \frac{v - u}{t}$$

b) The displacement, **s**, is equal to the area under the graph.

The rectangular part has an area of **ut**

The triangular part has an area of 1/2 x base x height

$$= \frac{1}{2} \times t \times (v-u)$$
$$= \frac{1}{2} \times \frac{t^2}{t} \times (v-u)$$
$$= \frac{1}{2} \times t^2 \times \frac{(v-u)}{t}$$
$$= \frac{1}{2} \times t^2 \times a$$

Total area gives us **s = ut + ½ at^2**

6. a) Horizontal component = 100cos60 ms^{-1}

= 50ms^{-1}

Vertical component = 100sin60 ms^{-1}

= 86.7ms^{-1}

b) Let the time taken be **t** seconds given by

$v = u + at$

$\Rightarrow \quad 0 = 86.7 - 10t$

$\Rightarrow \quad t = 8.7$

It takes 8.7s to stop climbing.

c) The height reached is given by

$v^2 = u^2 + 2as$

$\Rightarrow \quad 0 = 86.7^2 + 2 \times (-10) \times s$

$\Rightarrow \quad s = 375.8$

It reaches a height of 375.8m

d) Horizontal displacement = average velocity Htime

= 50 x (2x8.7)

= 870 Object lands 870m away.

7. a) Let **v** ms^{-1} be his vertical velocity given by

$$v^2 = u^2 + 2as$$
$$\Rightarrow \quad v^2 = 0 + 2 \times 9.8 \times 45$$
$$= 882$$
$$\Rightarrow \quad v = 29.7$$

30 ms^{-1}

(UNFINISHED)¬

b) The time of flight, **t**, is given by v = u + at

$$\Rightarrow \quad 29.7 = 0 + 9.8t$$
$$\Rightarrow \quad t = 3$$

The skier is in the air for 3s

c) The horizontal flight distance is given by

$$s = \bar{v}t$$
$$= 40 \times 3$$
$$= 120$$

Horizontal distance is 120m

FORCE REVIEW ANSWERS

1. A force of 1N

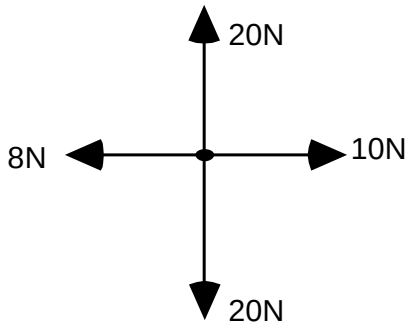
2. a) F=ma gives 17 = m×1.8 Thus m = 9.4

   The mass is 9.4 kg

   b) F=ma gives $2\times10^4 = 1.25\times10^3 a$ Thus a = 16

   The acceleration is $16ms^{-2}$

3. a)



   b) F=ma gives 2 = 2a Thus a = 1

   It accelerates at $1ms^{-2}$ horizontally.

4. a) Vertical height in one step = 0.2m

   No. of steps = 60

   ΨTotal vertical height of stairs = 60×0.2 = 12m

   Weight of girl = 500N

   Work done by girl = Fs = 500 × 12 = 6000J

   Time taken to climb the stairs = 20s

   Power = E_w/ t

   Power = 6000/20 = 300

   The power of the girl climbing the stairs is 300W.

b) E_p of bob at highest point = mgh

$=1.0\times10\times0.45 =4.5J$

$\Rightarrow$total energy at highest point = 4.5J

$\Rightarrow$total energy at lowest point = 4.5J

$\Rightarrow E_k$ at lowest point = 4.5J

$\Rightarrow 1/2\ mv^2 = 4.5$

$\Rightarrow 1/2 \times1.0\times v^2 =4.5$

$\Rightarrow v^2 = 9.0$

$\Rightarrow v = 3.0$

The speed of the bob at its lowest point is $3.0ms^{-1}$.

SECTION 1.4 TEST ANSWERS

1. Momentum is the product of a body's mass and velocity, p=**mv**

2. Momentum is conserved in all circumstances.

3. A collision in which both momentum and kinetic energy are conserved.

4. A collision in which an object loses some of its kinetic energy.

5. a) Initial momentum = 5x10 + 3x5

= 65

Final momentum = 5**v** + 3x9

$$5v + 27 = 65$$
$$\Rightarrow \quad 5v = 38$$
$$\Rightarrow \quad v = 7.6$$

= 5**v** +27

Since momentum is conserved,

The final velocity of the heavier trolley is 7.6ms^{-1}

b) Initial kinetic energy

$$= \frac{1}{2} \times 5 \times 10^2 + \frac{1}{2} \times 3 \times 5^2$$
$$= 287.5 Joules$$

$$= \frac{1}{2} \times 5 \times 7.6^2 + \frac{1}{2} \times 3 \times 9^2$$
$$= 265.9 J$$

Final E_k

Thus kinetic energy is lost and the collision is inelastic.

6. Initial momentum is zero

Final momentum = 5**v** + 0.006x312.5

= 5**v** + 1.875

Since momentum is conserved, 5**v** + 1.875 = 0 which gives us that

v = -0.375

The rifle moves with a velocity of 0.375ms^{-1} in the opposite direction to the bullet.

7. Since momentum is conserved, the change in **A**'s momentum must equal the change in **B**'s momentum but be in the opposite direction;

$$m_a v_a - m_a u_a = -\left(m_b v_b - m_b u_b\right)$$
$$\Rightarrow \quad m_a\left(v_a - u_a\right) = -m_b\left(v_b - u_b\right)$$

But this change only occurs while the bodies interact and so the time of change is the same for both;

$$\Rightarrow \quad m_a \frac{\left(v_a - u_a\right)}{t} = -m_b \frac{\left(v_b - u_b\right)}{t}$$
$$\Rightarrow \quad m_a a_a = -m_b a_b$$

But the unbalanced force acting on a body is given by **F=ma**, so we have that $\mathbf{F_a = -F_b}$. This is the same expression as Newton's third law.

8. Impulse = force **x** time

9. Impulse = change in momentum.

10. Since we know the initial and final velocities of the 8kg boulder, we can calculate its momentum change which is 8 x 4kgms^{-1} = 32kgms^{-1}.

Thus the impulse on the 10kg boulder, which is the same as the impulse on the 8kg one, is 32kgms^{-1}

SECTION 4.1 TEST ANSWERS

1. a) metre

   b) kilogram

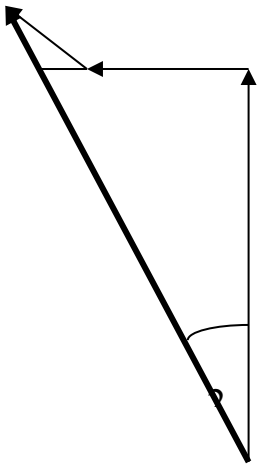
   c) metres per second squared

   d) metres per second

   e) kilogram per cubic metre

   f) Newton second

2.



The resultant velocity of the sick is 13.8 ms^{-1} ,

14ms^{-1} @ 20^{o} W of N.

Do not use too many sig fig and be accurate in your drawings.

3. This question is checking your ability to stick to a

$$F = ma$$
$$1 = 3a$$
$$a = \frac{1}{3}$$
$$a = 0.3$$

significant number of figures.

The acceleration is 0.3 ms $^{-2}$.

You must not write any more than one sig. fig. as this is the level of accuracy given in the question.

4. This question is checking that you are aware of prefixes used in Physics.

m = 0.1g = 0.1×10^{-3} kg

W=mg

W=$0.1 \times 10^{-3} \times 9.8 = 9.8 \times 10^{-4}$N

$F=9.48 \times 10^{-4} N$

$W=9.8 \times 10^{-4} N$

Unbalanced force =)F

$F=0.32 \times 10^{-4} N$

$F=ma$

$0.32 \times 10^{-4} = 0.1 \times 10^{-3} a$

$a=0.32 ms^{-2}$

5. a) 5.0×10^{-3} A

b) 3.0×10^{-5} F

c) 2.00×10^{2} s

d) 4.5×10^{-5} F

SECTION 4.2 TEST ANSWERS

1. ½ scale division) reading H 100%

   5/37 H 100% =13.5%

2. a) Fluff on a wheel, wind, door opening during an experiment etc.

   b) Zero errors on equipment, bad design (give egs) etc.

3. mean =Ex)n

   1.58+1.55+1.59+1.56+1.56+1.58= 9.42

   mean average =1.57

   approx. random error = (max-min)) no. of readings

   = (1.59-1.55))6 =(0.04))6 =0.0067

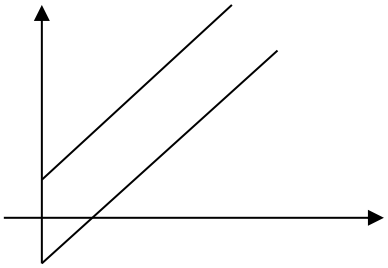
   % uncertainty = a.r.e.) mean H100%

   % uncertainty= 0.0067)1.57H100% = 0.42%

4. You must be aware that any experiment is liable to error, just look for them!

5. You can reduce your error by taking many readings, **but this will not help improve the accuracy if you have a systematic error**.

6. The best measurement that we can hope for is that the mean value is close to the "true" value.

7. 

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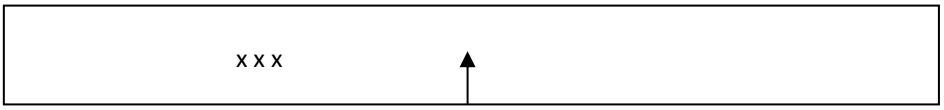

readings.

8. a) (0.01/0.12)H 100% = 8.3%

b) (0.1/1.0)H 100% = 10%

9. mean =Ex)n

0.97+0.92+1.07+1= 3.96

mean average =0.99

approx. random error = (max-min)) no. of readings

= (1.07-0.92))4 =(0.15))4 =0.0375

% uncertainty = a.r.e.) mean H100%

% uncertainty= 0.0375)0.99H100% = 3.8%

However, as one of the results is recorded only to one sig fig this level of accuracy ought to be used throughout.

b) The error made was that as one of the answers was 1.00 this was wrongly recorded as 1.

10. Find the largest percentage error in the measurements

0.01/1.00H100% = 1.0%

0.02/0.16H100% = 12.5%

The error in the speed calculation will be 12.5%

speed = distance/time

= 1.00/0.16

= 6.25 ms^{-1}

Speed = 6.25 ms^{-1}∀ 12.5%

or

Speed = 6.25∀0.78 ms^{-1} (where 0.78 is 12.5% of 6.25)