Candidate Name	Centre Number					Candidate Number				
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GCSE

SCIENCE (Double Award)

UNIT 6: (Double Award) PHYSICS 2
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**12**	
3.	**10**	
4.	**6**	
5.	**8**	
6.	**4**	
7.	**15**	
Total	**60**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **4** is a quality of extended response (QER) question where your writing skills will be assessed.

Equations

$\text{speed} = \dfrac{\text{distance}}{\text{time}}$	
$\text{acceleration [or deceleration]} = \dfrac{\text{change in velocity}}{\text{time}}$	$a = \dfrac{\Delta v}{t}$
acceleration = gradient of a velocity-time graph	
resultant force = mass × acceleration	$F = ma$
weight = mass × gravitational field strength	$W = mg$
work = force × distance	$W = Fd$
force = spring constant × extension	$F = kx$

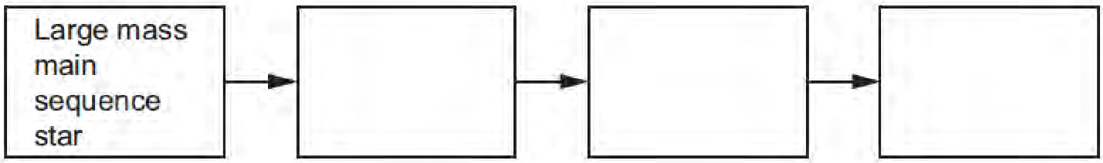
SI multipliers

Prefix	Multiplier
m	1×10^{-3}
k	1×10^{3}
M	1×10^{6}

*Answer **all** questions*

1. (a) Select the correct words from the list below to complete the life cycle of a large mass star. [3]

white dwarf **red giant** **neutron star** **supergiant** **supernova**



(b) Explain in terms of forces why main sequence stars are stable. [2]

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5

2. A class of students used dice to model radioactive decay. Each of 8 groups gathered data.

(a) Put the following steps from their method in order in the boxes below. [3]

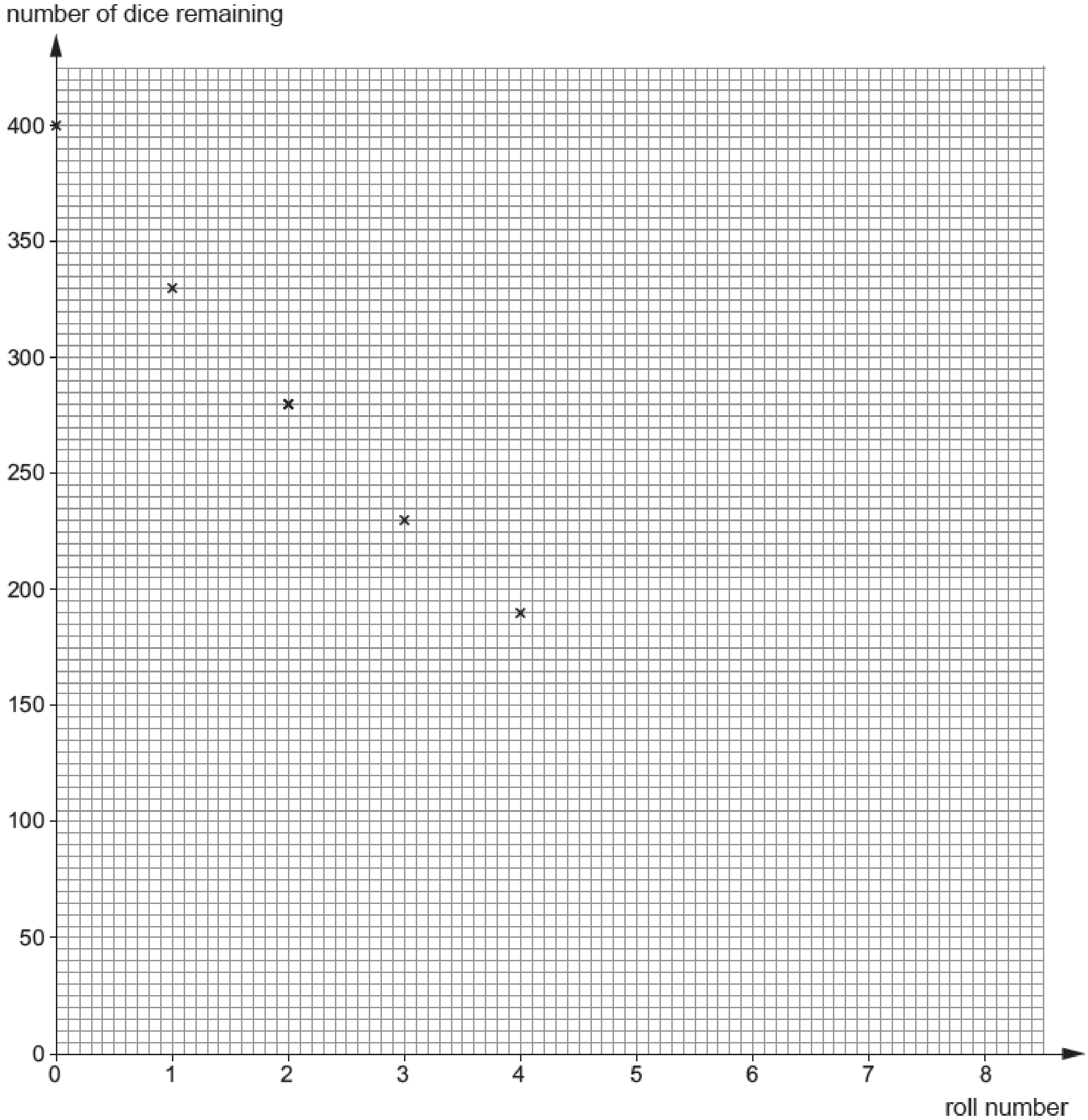
A. Each group's results were added together to give the class results.
B. Each group of students counted 50 dice.
C. The remaining dice were counted.
D. The dice were rolled.
E. Any that landed with a 6 facing upwards were removed.
F. The remaining dice were rolled again.

B			C		

The table shows the class results.

Number of rolls	Number of dice remaining
0	400
1	330
2	280
3	230
4	190
5	160
6	130
7	110
8	90

(b) The graph shows part of the data from the whole class. Plot the remaining data and draw a suitable line. [3]



(c) The half-life of a radioactive isotope is the time taken for half of the nuclei to decay. Dice can be used to model radioactive decay and half-life because dice have a certain probability of 'decay'. Different isotopes have different probabilities of decay and therefore different half-lives. The dice used in this experiment had a 1 in 6 probability of decaying on each throw.

(i) Use the graph to determine the half-life of the dice in the experiment, showing clearly the method used. [2]

half-life = ……………… rolls

(ii) The experiment was repeated with 20 sided dice. Explain how this would affect the value of the half-life. [2]

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(iii) Explain why the data from each group were added together. [2]

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12

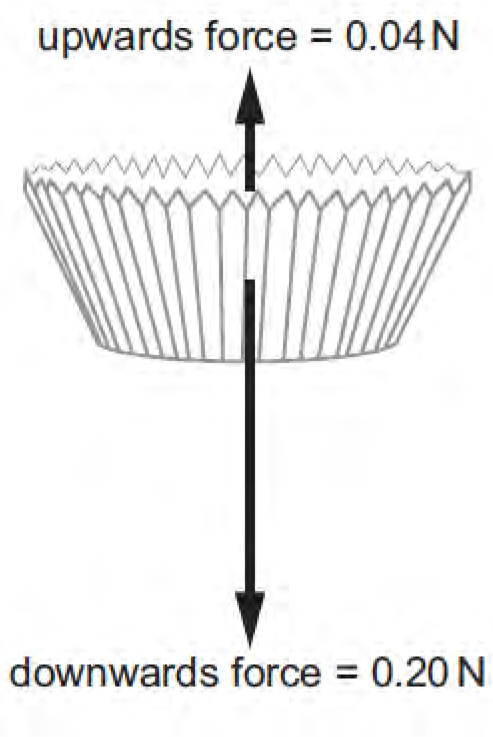
3. Read the information below and answer the questions that follow.

The physicist and mathematician Sir Isaac Newton was born in 1643. He is famous for the laws of motion which describe the effect of forces on mass. The mass of an object is a fundamental property of that body and is a measure of its inertia whereas the weight of a body is dependent on where it is in the Universe. Gravitational field strength on the Earth has a value of 10 N/kg whereas on the Moon the gravitational field strength is 1.6 N/kg.

(a) Read the following statements and tick (✓) the boxes alongside the correct statements. [2]

The weight of a body is measured in kg	☐
The mass of a body is much lower on the Moon	☐
The inertia of a body does not change on a different planet	☐
The gravitational force on a 2 kg body on the Moon is 3.2 N	☐

(b) A student investigates the motion of objects falling through the air using cake cases. She drops a stack of cake cases of mass 0.02 kg from a height of 1.5 m. The diagram shows the forces acting on the cake cases soon after they are dropped.



(i) Name the upwards force that is acting on the cake cases. [1]

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(ii) Calculate the resultant force that is acting on the cake cases. [2]

force = ……….. N

(iii) Use the equation:

$$\text{acceleration} = \frac{\text{resultant force}}{\text{mass}}$$

to calculate the acceleration of the cake cases. [2]

acceleration = ……….. m/s^2

(c) Describe and explain how the acceleration of the cake cases changes over the next few seconds of the journey. [2]

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(d) State the value of the upwards force when the cake cases travel at terminal velocity. [1]

force = …………. N

10

4. Our solar system consists of the Sun along with a variety of different objects and planets. Name these and describe some of their features and their relative positions. [6 QER]

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5. Read the information below then answer the questions that follow:

Dimitri Mendeleev predicted the existence of an element with atomic number 43 in 1871. Element 43, now known as technetium, was actually discovered in 1937. The name technetium comes from the Greek word 'technetos' meaning artificial, since technetium is a man-made isotope. One form of an isotope of technetium is ${}^{99}_{43}\mathrm{Tc}$ which is used in nuclear medicine as a tracer. It has a half-life of 6 hours. A patient is injected with the isotope and when a technetium-99 nucleus decays it emits gamma radiation which is easily detected outside the body. This technique is used to tell us about the function of parts of the body such as the heart, liver and lungs.

(a) Read the following statements and tick (✓) the box alongside the 2 correct statements. [2]

There are 99 neutrons in a nucleus of technetium-99 ☐

There are 43 protons in nucleus of technetium-99 ☐

There are 43 neutrons in nucleus of technetium-99 ☐

Technetium-99 is not found in the earth's crust ☐

Technetium was discovered by Mendeleev ☐

(b) State why a nucleus of technetium is unstable. [1]

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(c) Technetium-99 decays by gamma emission. Complete the table below. [2]

Radiation	**Nature**
Alpha	....
Beta	Fast moving electron
Gamma	....

(d) Technetium-99 has a half-life of 6 hours and it is the most widely used radio-isotope in the world for medical procedures. Explain why technetium-99 is used as a tracer. [3]

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6. (a) When a box is lifted and placed on a shelf 0.5 m off the ground 20 J of work is done on it. Use the equation:

$$\text{force} = \frac{\text{work done}}{\text{distance}}$$

to calculate the force used to lift the box. [2]

force = ……………….. N

(b) When work is done on the box energy is transferred to it. What type of energy does the box store when it is on the shelf? [1]

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(c) What happens to this energy if the box is knocked off the shelf? [1]

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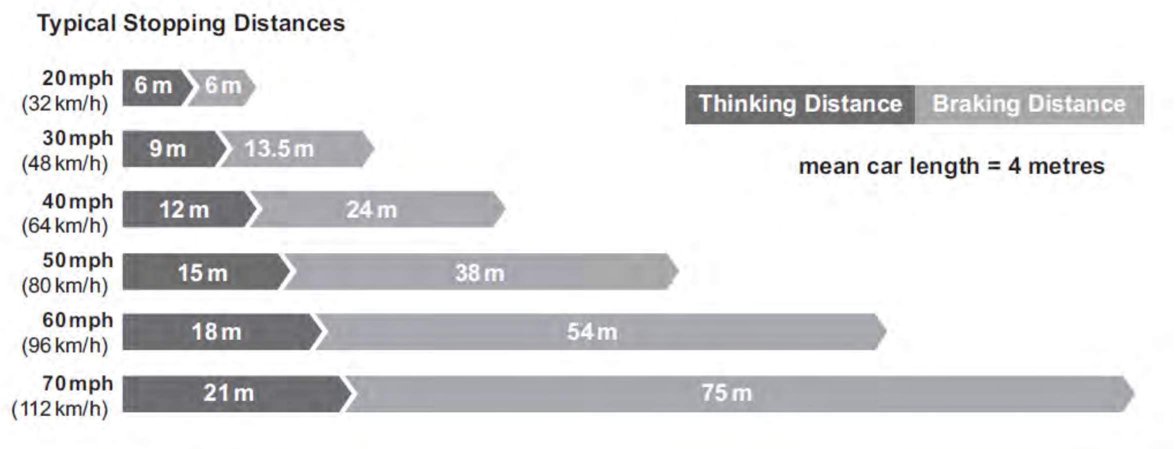
4

7. Read the information below then answer the questions that follow.

Speed is a critical factor in all road traffic accidents (RTA). Driving is unpredictable and if something unexpected happens on the road ahead – such as a child stepping out from between parked cars – it is a driver's speed that will determine whether they can stop in time, and if they can't stop - the size of the impact force.

Hence reducing and managing traffic speeds is crucial to road safety. It has been estimated that for every 1 mph reduction in mean speeds, RTA rates fall by an average of 5%. Breaking the speed limit or travelling too fast for the road conditions is recorded as a contributory factor in more than one in four (28%) serious RTAs in the UK. Research has found that British drivers who regularly exceed the speed limit are nearly twice as likely to have been involved in a RTA.

Stopping distances include the distance travelled while the driver notices a hazard and applies the brakes (thinking distance), and while the vehicle comes to a full stop from its initial speed (braking distance). Typical minimum stopping distances for cars are shown below.



Source: Department for Transport, 2007

Technology such as anti-lock brakes and stability control are designed to enable greater control over the vehicle, not shorten stopping distances. There may be a very small reduction in braking distance with modern technology, but not enough to significantly affect overall stopping distance. Technology such as air bags is designed to reduce the harm to passengers in the event of a RTA. Whatever technology a vehicle has, the basic fact remains that the bigger the speed, the longer the stopping distance, and the less chance of stopping in time in an emergency.

Adapted from: http://www.brake.org.uk/news/15-facts-a-resources/facts/1255-speed

(a) Read the following statements and tick (✓) the boxes next to the correct statements. [2]

A speed limit of 30 mph indicates that it is **always** safe to travel at 30 mph in that area ☐

Cars always have a braking distance of 24 m at 40 mph ☐

Travelling twice as fast always doubles the thinking distance ☐

The typical minimum overall stopping distance at 50 mph is 53 m ☐

(b) Explain in practice why actual stopping distances may differ from the minimum distances shown on the diagram. [3]

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(c) Describe the relationship between speed and braking distance shown in the diagram. [2]

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(d) Using the patterns shown in the data, calculate the overall stopping distance at 80 mph. [3]

stopping distance = …………………. m

(e) (i) The text suggests that air bags reduce the harm to passengers in the event of an accident. Explain how they do this. [2]

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(ii) Name another safety feature of cars other than air bags. [1]

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(f) The text states that: "It has been estimated that for every 1 mph reduction in mean speed, crash rates fall by an average of 5%." Suggest measures that are taken to encourage people to drive more slowly. [2]

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