Rugby School

Sixth Form Entrance Examination

Specimen Paper

PHYSICS

Time allowed: 60 minutes

SECTION A

Use the attached 'Multiple Choice Answer Sheet' at the back of this booklet to give your answer to the following multiple questions. You may detach the sheet but remember to write your name and school in the space provided.

Indicate your answer by joining the dots under your chosen letter using a dark (HB) pencil. Ensure you have only one clear answer for each question.

Q1 A racing car accelerates from 10m/s to 25m/s in 5 seconds. What is its average acceleration?

A $3m/s^2$

B $7m/s^2$

C $5m/s^2$

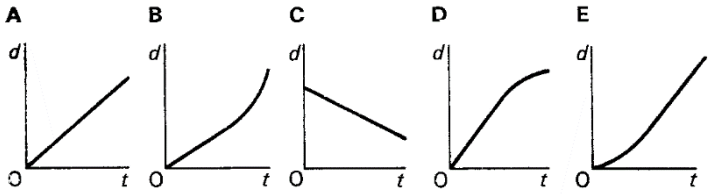
D $15m/s^2$

E $2m/s^2$

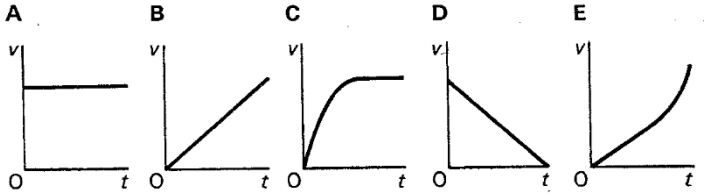
Questions 2-4

An Apollo astronaut on the Moon with no atmosphere released a hammer from rest and it fell to the Moon's surface.

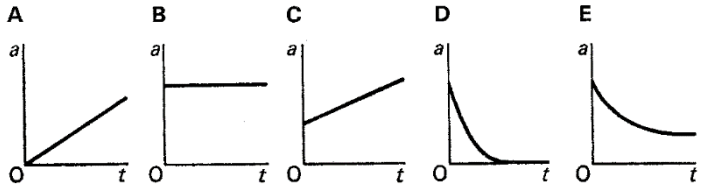
Q2 The graph of its distance *d* against time *t* during its fall is



Q3 The graph of its velocity *v* against time *t* is

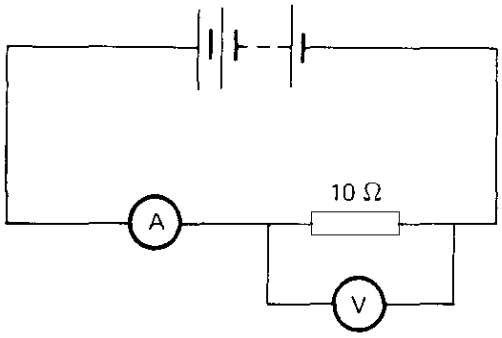


Q4 The graph of its acceleration *a* against time *t* is



Questions 5-6

In this circuit, the reading on the ammeter is 0.5A.



Q5 The reading on the voltmeter is

A 2V

B 5V

C 8V

D 12V

E 20V

Q6 If the 10 ohm resistor is replaced with a 15 ohm resistor the reading on the voltmeter is

A 2V

B 7.5V

C 5V

D 10V

E 12V

Questions 7-8

A plastic rod is rubbed on a dry cloth and the rod becomes positively charged.

Q7 The rod has

A gained electrons

B lost electrons

C gained protons

D lost protons

E changed electrons into protons

Q8 The cloth has

A a positive charge equal to that on the rod

B a negative charge equal to that on the rod

C a positive charge less than that on the rod

D a negative charge greater than that on the rod

E no charge

Q9 A pure red lipstick, when viewed in a pure blue light looks

A red

B blue

C black

D white

E magenta

Q10 An echo sounder on a ship sends waves towards the sea floor. The echo is received after an interval of 3 seconds. If the speed of sound in water is 1500m/s, the depth of the sea floor is

A 750m

B 4500m

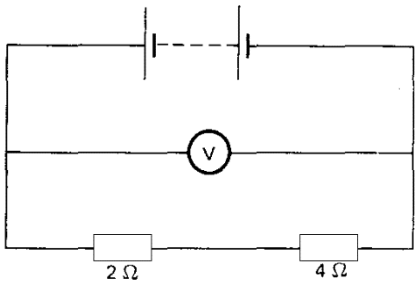
C 9000m

D 2250m

E 500m

Questions 11-12

In this circuit, the voltmeter reading is 12V.



Q11 The combined resistance of the 2Ω and4 Ω resistors in series is

A 2 Ω

B 3 Ω

C 4 Ω

D 6 Ω

E 8 Ω

Q12 The current flowing through these resistors is

A 2A

B 3A

C 4A

D 6A

E 12A

Q13 Which of the following statements is **NOT** correct?

A 1M Ω (Megaohm) = 1000000 Ω

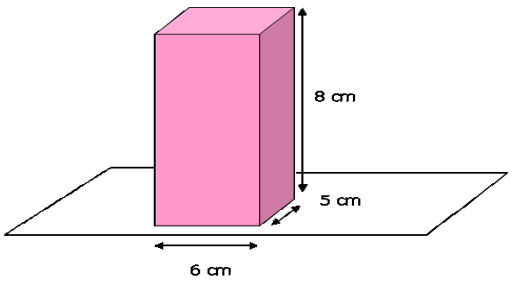
B 1kV (kilovolt) = 100V

C 1mA (milliamp) = $\frac{1}{1000}$ A

D 1μA (microamp) = $\frac{1}{1000000}$ A

E 1nA (1 nanoamp) = $\frac{1}{1000000000}$ A

Q14 A block of mass 480 g rests on a desk as shown. What is the density of the block?



A 12 g/cm^3

B 2 kg/m^3

C 12 kg/m^3

D 480 g/cm^3

E 2 g/cm^3

Questions 15-17

A boy whose weight is 300 newton takes 5 seconds from rest to run upstairs to a floor which is 4 metres higher.

Q15 The work he does against gravity, measured in joules, is

A 6000

B 1500

C 1200

D 600

E 240

Q16 His average power, in watts, is

A 6000

B 1500

C 1200

D 600

E 240

Q17 Which of the following statements is false?

A his potential energy decreases

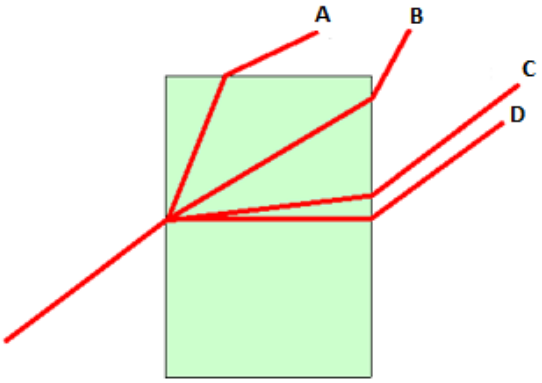
B his kinetic energy changes

C he uses chemical energy

D his power depends on his speed

E he does work against his weight

Q18 Which of these lines shows the path of a ray of light through a glass block?



Q19 If the speed of sound in air is 330 metres per second, the wavelength in metres of a note of frequency 550 hertz is

A 181500

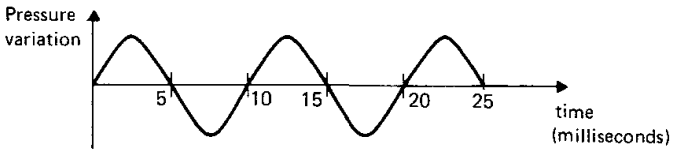
B 550

C 330

D 5/3

E 3/5

Q20 The graph below shows the pressure variation of a sound wave as displayed on a cathode ray oscilloscope connected to a microphone.



The frequency of the wave is

A 50 Hz

B 100 Hz

C 200 Hz

D 5 000 Hz

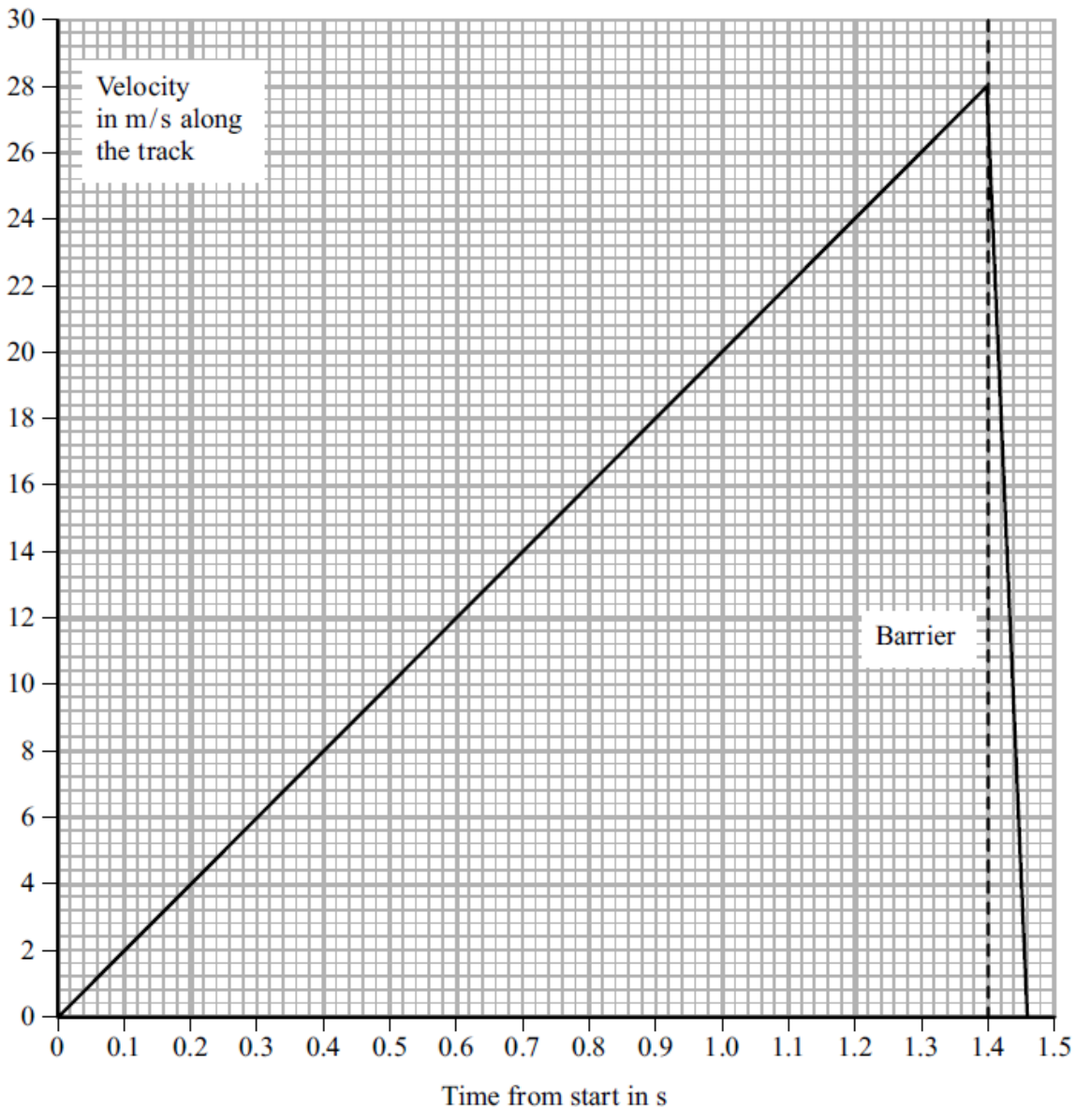
E 10000 Hz

THE END

SECTION B

Q1 Crash tests are used to measure the safety of new car designs. In one type of test, a car accelerates along a straight and level track and then crashes into a barrier.

(a) The velocity-time graph shows one set of results.



Use information from the graph to answer the questions.

(i) Calculate the acceleration of the car from the start to the barrier.
Show your working and give the unit.

.....

.....

Acceleration = ...
(3)

(ii) Calculate the distance in metres the car travels from the start to the barrier.
Show your working.

.....

.....

Distance = ... m
(3)

(iii) The car hits the barrier and a short time later it stops.
How long in seconds is this short time?

.....

Time = ... s
(1)

(b) (i) State the equation which relates acceleration, mass and unbalanced force.

.....
(1)

(ii) When another car hits the barrier, it experiences an unbalanced force of 25 000 N and decelerates at 20 m/s^2.
Calculate the mass in kilograms of the car.

.....

.....

Mass = ... kg
(2)

(Total: 10)

Q2 A class of students was taken to a materials-testing laboratory. The diagram shows an impact tester that they saw during their visit. The tester measures how much energy is needed to fracture a specimen of a material.

The mass is raised as in Figure 1. When released it falls and collides with the specimen. If the specimen fractures, the mass may have sufficient energy to follow through up to a certain height as in Figure 2.

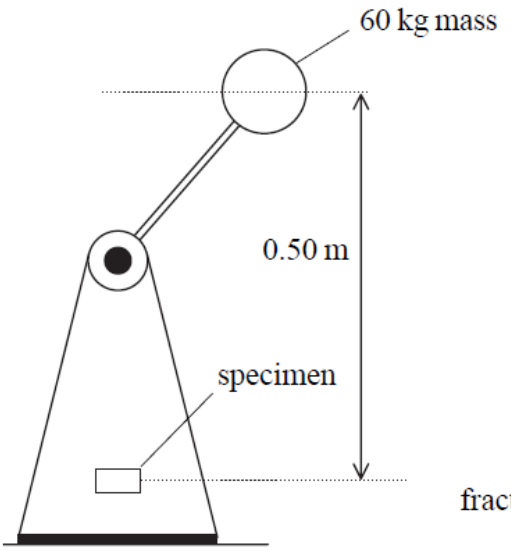


Figure 1

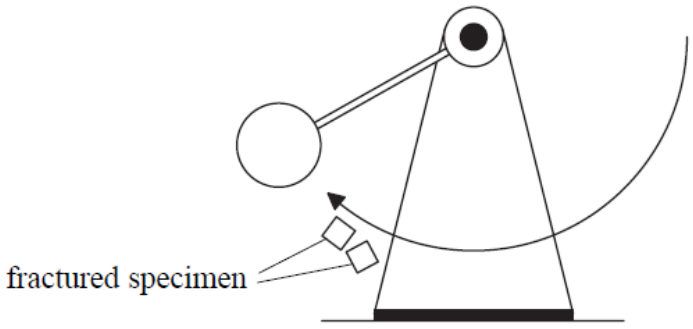


Figure 2

(a) Use the phrases from the box to write a word equation.

energy required to fracture the specimen
final gravitational potential energy of the mass
initial gravitational potential energy of the mass

.....

.....

.....

.....

(1)

(b) Before the test, the 60 kg mass was raised 0.50 m.

(i) Calculate its initial increase in gravitational potential energy in joules.

.....

.....

Initial increase in gravitational potential energy = ... J

(2)

(ii) State the kinetic energy in joules of the mass just before it strikes the specimen.

Kinetic energy = ... J

(1)

(iii) Calculate the speed in metres per second of the mass just before it strikes the specimen.

.....

.....

Speed = ... m/s

(2)

(iv) Why might the speed be less than that calculated in (i)?

.....

.....

(1)

(v) The specimen fractures and the mass retains 70 J of its initial gravitational potential energy. Calculate the energy required in joules to fracture the specimen.

.....

.....

Energy required = ... J

(2)

(vi) Explain what is meant by the principle of conservation of energy

.....

.....

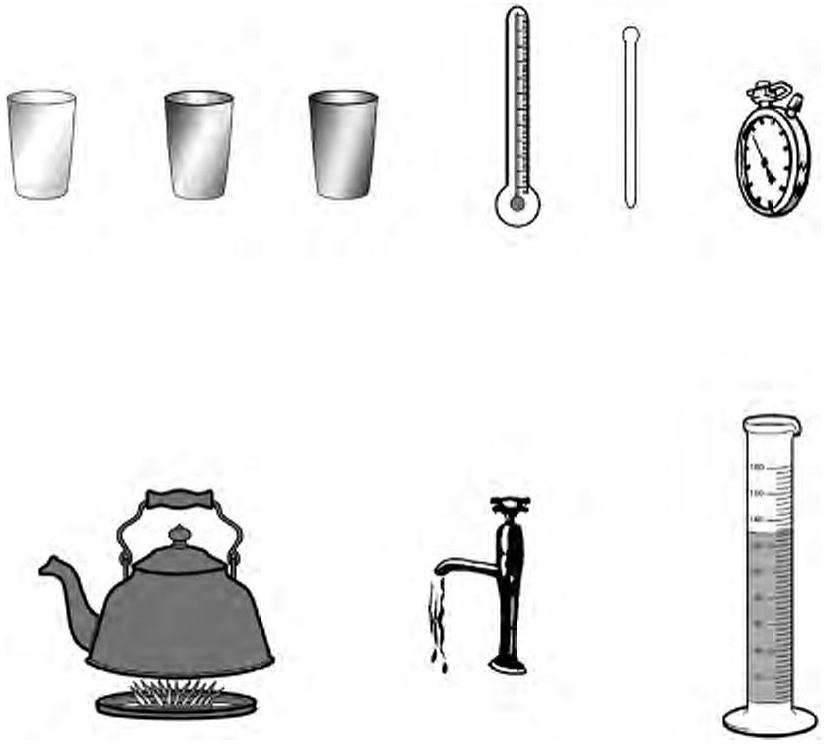
(2)

(Total: 11)

Q3 A student is asked to investigate the properties of three different cups.

The cups are all of the same size and shape but made from different materials. These cups keep drinks hot for as long as possible.

She has the following apparatus.



(a) Describe how the student would use the apparatus to determine which cup keeps the liquid hottest.

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Continue writing on the next page

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(8)

(b) List two things that she should keep constant when comparing cups in this investigation.

1 .....

2 .....

(2)

(Total: 10)

Q4

A student uses a telescope to look at the craters on the Moon.

He decides to investigate how a crater is produced. He drops a ball bearing onto the smooth surface of some dry sand.

(a) Suggest and explain **two** reasons why the student uses dry, rather than damp, sand.

1 .....

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.....

(2)

2 .....

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(2)

(b) Before he drops the ball bearing, the student makes sure that the surface of the sand is flat and level.

Suggest **two** reasons why.

1 .....

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2 .....

.....

(2)

(c) The student repeats his experiment several times.

Suggest **two** reasons why.

1 .....

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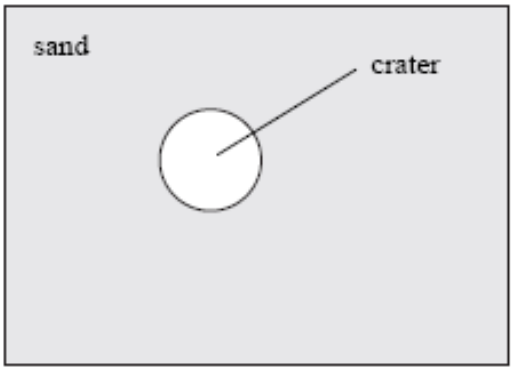
2 .....

.....

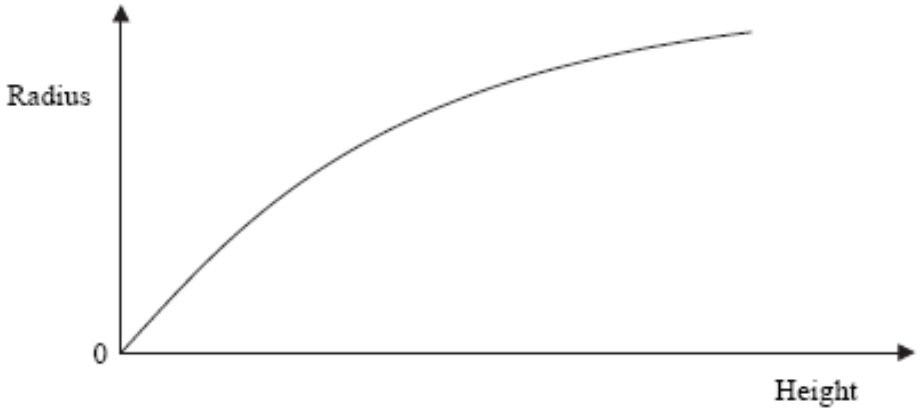
(2)

(d) The diagram shows the outline of a crater in the sand.
Measure its diameter in millimetres.



Diameter = ... mm
(1)

(e) The ball bearing is dropped from different heights. The sketch graph shows the general pattern of results.



What conclusion can the student come to on the basis of this graph?

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(1)

(Total: 10)

End of paper