Velocity and Acceleration

This page has some whopping great questions on it. Take a deep breath and give 'em your best shot. Give all answers to one decimal place.

Q1 A team of pilots are testing a prototype of a new kind of rocket.

Don't let all these units give you brainache. These are easy marks in the exam.

a) It's 20 000 kilometres from Manchester to Sydney, Australia. The rocket does the journey in 4 hours. What was the average speed for the trip in m/s?

b) If the rocket could go straight through the centre of the Earth, the distance is only 12 740 km. If the rocket travelled at the same speed, how long would it take to get to Sydney?

c) From lift-off, the team can get the rocket up to 2 km/s in 14 seconds. What's the acceleration of the rocket in m/s^2?

Q2 It's 70 miles by road from Birmingham to Oxford. The journey usually takes me 1 hour and 10 minutes on the motorway.

1 mile = 1.609 km

a) How far is the journey in kilometres?

b) What's my average speed during the journey in mph and km/h?

c) I could get to Oxford in 45 minutes if I went faster. How fast would I have to go and would this be legal? (The motorway speed limit is 70 mph.)

d) Yesterday I overtook a caravan that was doing 80 km/h. The velocity of my car increased from 80 km/h to 110 km/h in 4 seconds. What was my acceleration, in m/s^2?

Q3 Sound travels at a rather stately 330 m/s in air.

Light travels around 1000 times faster than sound, so assume the lightning is seen the instant it strikes.

a) I looked at my watch the moment I saw a flash of lightning and heard the thunder 12 seconds later. To the nearest kilometre, how far away did the lightning strike?

b) A girl and boy are standing under a tree. The boy starts running, accelerating at 0.2 m/s^2. What speed is he running at when he reaches the middle of the field 18 seconds later?

c) The middle of the field is 32.4 m away. What was the boy's average speed?

d) If the girl yells at the boy from under the tree, how long will it take her voice to reach him?

e) The next flash of lightning lights up the sky. It takes 18 s this time before I hear the rumble of thunder. How far away is it now? Is is getting closer or further away?

Velocity and Acceleration — that famous comedy duo...

Physics — it's all so useful. Handy for all kinds of situations. Driving, athletics, thunderstorms... oh and let's not forget the EXAMS. Those formulas need to be stuffed into your overflowing grey cells, ready to leap onto the paper and make the examiner drop his hobnob in his tea with delight.

See the "Speed, Velocity and Acceleration" pages of our Physics Revision Guides

Answers

Page 4 Electrical Power

Q1 a) 18 W b) 16 W c) 27 W d) 9 W e) 2.4 W f) 16.8 W g) 22.5 W h) 5 W i) 51.3 W
Q2 a) 5 V b) 2.5 V c) 20 V d) 500 V e) 2.25 V f) 50 V g) 1250 V h) 625 V i) 37.5 V
Q3 a) 50 A b) 2000 A c) 2000 A d) 60 A e) 4500 A f) 12.5 A g) 110 A h) 800 A i) 400 A
Q4 a) 1380 A b) 1058 A c) 10 A d) 13 A

Page 5 Electrical Power

Q1 a) 150 V b) 125 V c) 250 V d) 2.5 A so use a 3 A fuse.
Q2 a) 1196 W b) 1403 W c) 3 A fuse d) 13 A fuse e) 800 W f) 2.5 A
Q3 a) 2.6 A b) 120 V c) 30 A fuse d) 40 A fuse

Page 6 Resistance

Q1 a) 2 Ω b) 4 Ω c) 3 Ω d) 1 Ω e) 6 Ω f) 3 Ω g) 4.5 Ω h) 0.25 Ω i) 0.5 Ω
Q2 a) 6 V b) 10 V c) 16 V d) 18 V e) 2 V f) 9 V g) 4.5 V h) 3 V i) 12 V
Q3 a) 2 A b) 3 A c) 3 A d) 2 A e) 3 A f) 1 A g) 0.5 A h) 0.25 A i) 0.6 A
Q4 a) 5 Ω b) 2.4 A Q5 a) 46 A b) 24 A

Page 7 Resistance

Q1 a) 24 Ω b) 15 Ω c) 5 A
Q2 a) 12 Ω b) 2 A c) 6 V d) 19.1 A
Q3 a) 12.8 A b) 1.7 A c) 27 V d) 35.4 Ω

Page 8 Energy in Kilowatt-hours

Q1 a) 6 kWh b) 12 kWh c) 24 kWh d) 5 kWh e) 3 kWh f) 15 kWh g) 48 kWh h) 0.3 kWh i) 0.2 kWh
Q2 a) 2 kW b) 3 kW c) 8 kW d) 0.5 kW e) 1.5 kW f) 0.75 kW g) 11.5 kW h) 22.5 kW i) 1.2 kW
Q3 a) 1 h b) 3 h c) 6 h d) 0.5 h or 30 mins e) 0.25 h or 15 mins f) 0.75 h or 45 mins g) 2 h h) 12 h i) 0.06 h or 3.6 mins
Q4 a) 105 kWh b) 7.5 kWh c) 2/3 hr or 40 mins d) 24 kW

Page 9 Cost of Electricity

Q1 a) £7.50 b) £75 c) £6.75 d) £11.25 e) £37.50 f) £120 g) £38.70 h) £74.85 i) £2595.90
Q2 a) 10 units b) 20 units c) 200 units d) 1000 units e) 562.5 units f) 6250 units g) 9375 units h) 647.5 units i) 9465 units
Q3 a) 7 p b) 14 p c) 10 p d) 9.3 p e) 10.8 p f) 12.7 p g) 8.5 p h) 12.2 p i) 11.1 p
Q4 a) 1682.1 units b) £134.57 c) 2625 units d) 6.5 p

Page 10 Energy and Cost

Q1 a) 4 h b) 26.25 kWh c) 1½ h extra
Q2 a) 13.5 kWh b) 3.5 h c) 6 p
Q3 a) 75 mins b) 5 kWh c) 45 p d) £2.03

Page 11 Force and Motion

Q1 a) 50 N b) 35 N c) 376 N d) 2.3 N e) 2.1 N f) 220.4 N g) 253.3 N h) 8411.6 N i) 5.3 N
Q2 a) 20 m/s² b) 5 m/s² c) 14 m/s² d) 6.4 m/s² e) 0.3 m/s² f) 6.3 m/s² g) 28 m/s² h) 3.9 m/s² i) 29.8 m/s²
Q3 a)10 kg b) 8 kg c) 38.3 kg d) 2.5 kg e) 5.7 kg f) 18.4 kg g) 65 kg h) 5.9 kg i) 15 kg
Q4 a) 3600 N b) 25.2 N c) 918 N d) 321.6 N e) 0.02 N f) 475.39 N g) 794.61 N

Page 12 Force and Motion

Q1 a) Rock b) Mini c) Skier d) Motorbike e) Sky-diver f) Magpie g) Horse
Q2 a) 5 m/s² b) 4 m/s² c) 5 m/s² d) -8 m/s² e) 0.6 m/s² f) 0.5 m/s² g) 4.2 m/s² h) 0.5 m/s²
Q3 a) 73.5 N b) 631 N c) 45 kg d) 58.8 N e) 5.4 m/s² f) 6.6 kg, to thief.

Page 13 Force and Motion

Q1 a) 2.5 m/s² b) Less push or more weight in tractor. c) 43 N d) No; no forces and so no deceleration.
Q2 a) 96 N b) 825 N c) 267
Q3 a) 6000 N b) 6000 N c) 2820 N in direct. of accel. d) 3020 N e) 2875, 4.6 m/s²

Page 14 Mass and Weight

Q1 a) 50 N b) 100 N c) 2270 N d) 325 N e) 5 N f) 35 N g) 3 N h) 2315 N i) 2.5 N
Q2 a) 0.6 kg b) 0.8 kg c) 14.3 kg d) 5 kg e) 32 kg f) 0.2 kg g) 3.4 kg h) 25.4 kg i) 0.05 kg
Q3 a) 8 N b) 16 N c) 363.2 N d) 52 N e) 0.8 N f) 5.6 N g) 0.48 N h) 370.4 N i) 0.4 N
Q4 a) Moon — g = 1.6 N/kg b) i) 650 N ii) 104 N c) i) 800 N ii) 128 N d) 5 kg e) 900 N

Page 15 Mass and Weight

Q1 a) 800 N b) 130 N c) 1.625 m/s²
Q2 a) 54.6 kg b) 1226 N c) 109.2 N
Q3 a) 41.7 kg b) 1250 N c) 833 N d) 437.5 N

Page 16 Speed and Velocity

Q1 a) 10 m/s b) 15 m/s c) 20 m/s d) 5 m/s e) 8.3 m/s f) 20.5 m/s g) 20 m/s h) 12.5 m/s i) 8.3 m/s
Q2 a) 300 m b) 400 m c) 200 m d) 420 m e) 2160 m f) 350 m g) 18000 m h) 8.3 km i) 60 km
Q3 a) 0.5 s b) 5 s c) 25 s d) 30 s e) 3.3 s f) 78.6 s g) 30 mins h) 41.6 mins i) 125 s
Q4 a) 1.1 m/s b) 0.2 cm/s c) 13.3 m/s d) 16.7 m/s e) 2.1 m/s f) 26.7 m/s g) 0.6 m/s h) 6.7 m/s i) 2000 m/s

Page 17 Speed and Velocity

Q1 a) 110.8 km/h b) 0 km/h c) 2 mins 24 s d) 180 km/h
Q2 a) Yes. b) 1134.3 km/h NE c) 53.5 mins d) No.
Q3 a) 3.3 m/s E b) 12 mins c) 90 s (twice as fast) d) 4.8 m/s e) 2.2 mins

Page 18 Acceleration

Q1 a) 0.5 m/s² b) 2.5 m/s² c) 4 m/s² d) 2 m/s² e) 0.8 m/s² f) 8.5 m/s² g) 1.3 m/s² h) 0.3 m/s² i) 18.7 m/s² j) 18.4 m/s²
Q2 a) 2 s b) 6 s c) 9 s d) 6.4 s e) 4.3 s f) 5 s g) 1.0 s h) 1.6 s i) 2.2 s j) 0.1 s
Q3 a) 0.05 m/s² b) 4 m/s² c) 0.05 m/s² d) 6.1 m/s² e) 5.1 s f) 5 s g) 5.6 s h) 11.1 m/s² i) 16.7 m/s (or 60 km/h); 50 m

Page 19 Velocity and Acceleration

Q1 a) 1388.9 m/s b) 2.5 h c) 142.9 m/s²
Q2 a) 112.6 b) 60 mph 96.6 km/h c) 93.3 mph No! d) 2.1 m/s²
Q3 a) 4 km b) 3.6 m/s c) 6.1 m/s d) 0.1 s e) 5940 m; further.

Page 20 Waves

Q1 a) 0.1 Hz b) 0.2 Hz c) 0.25 Hz d) 0.5 Hz e) 0.05 Hz f) 1 Hz g) 5 Hz h) 100 Hz
Q2 a) 0.05 s b) 0.5 s c) 10 s d) 0.001 s e) 0.004 s f) 0.25 s g) 500 s h) 0.008 s
Q3 a) 24 m/s b) 60 m/s c) 120 m/s d) 240 m/s e) 12 m/s f) 6 m/s g) 12000 m/s h) 96 m/s i) 14.4 m/s
Q4 a) 0.3 m b) 4 m c) 10 m d) 0.03 m e) 250 m f) 0.02 m g) 5 m h) 2 m i) 0.1 m
Q5 a) 2 m/s b) 2.4 m/s c) 0.25 m/s

Page 21 Waves

Q1 a) 0.5 Hz b) 10 m c) 1 m – 6 m/s, 4 m – 3.5m, 3 m – 6 m/s, 2 m – 12.5 Hz d) 4m
Q2 a) 900 m/s b) 6.67 cm c) 200 kHz
Q3 a) 3.001×10^8 m/s b) 4.007×10^{14} Hz

Page 22 Moments

Q1 a) 6 Nm Anti-CW b) 28 Nm CW c) 60 Nm CW d) 51.84 Nm Anti-CW
Q2 a) CW 9 Nm, Anti-CW 15 Nm, tip left. b) CW 34.5 Nm, Anti-CW 67.5 Nm, tip left. c) CW 55.2 Nm, Anti-CW 9.2 Nm ,tip right. d) CW 6.8 Nm, Anti-CW 6.58 Nm ,tip right. e) CW 6 Nm, Anti-CW 6 Nm, balance. f) CW 48 Nm, Anti-CW 25 Nm, tip right.
Q3 a) 10 N b) 20 Nm CW c) Cat goes down d) 1 m left of pivot.

Page 23 Moments

Q1 a) 32.5 Nm b) 13 N c) 300 N
Q2 a) 300 N b) 400 N c) 224 N d) Yes
Q3 a) Mom only 3 Nm b) 35.1 N c) 23.5 N d) Max dist; min force.

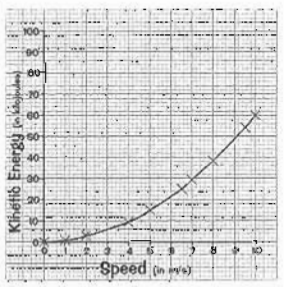
Page 24 Kinetic Energy

Q1 a) 31 J b) 500 J c) 1531 J d) 3125 J e) 1125 J f) 245 J g) 8681 J h) 6028 J i) 4500 J
Q2 a) 675 J b) 900 J c) 428 J d) 1575 J e) 882 J f) 603 J g) 936 J h) 401 J i) 684 J
Q3 a) 17.778 kg b) 10 kg c) 62.5 kg d) 4000 kg e) 3.906 kg f) 15.625 kg g) 640 kg h) 0.004 kg i) 360 kg
Q4 a) 1.25 J b) 482253 J c) 6 J d) 181476 J e) 181469 J f) 450000 J

Page 25 Kinetic Energy

Q1

Speed (m/s)	Kinetic Energy (joules)
0	0
1	800
2	2400
4	9600
5	15000
6.5	25350
7	29400
8	38400
9.5	54150
10	80000



Q2 a) 4000 kg b) 908000 J c) 12 teachers

Page 26 Gravitational Potential Energy

Q1 a) 0 J b) 3750 J c) 4500 J d) 32250 J e) 1800 J f) 50250 J g) 367.5 J h) 11250 J i) 16500 J j) 1500 J k) 7500 J l) 6750 J
Q2 a) 23544 J b) 22563 J c) 147150 J d) 21288 J e) 3139 J f) 13312 J g) 21974 J h) 1472 J
Q3 a) the 1.2 kg mass b) the 14.5 kg mass c) the 3.5 kg mass d) the 4.6 kg mass e) the 37 kg mass f) the 1000 kg mass
Q4 a) 111.87 m b) 5661.46 m c) 64.87 m d) 491.15 m e) 19450.07 m f) 1.65 m

Page 27 Gravitational Potential Energy

Q1 a) 2940000 kJ b) 490 kJ c) 85 kg d) Man in locker (it fell 3.5 m — only he's high enough for that to be possible)
Q2 a) 206 J b) 28 kg c) 0.75 m d) 19 N/kg

Page 28 Work Done = Force × Distance

Q1 a) 5 kJ b) 25 J c) 1.25 kJ d) 21.5 kJ e) 100 kJ f) 3.65 kJ g) 8.85 kJ h) 67.75 kJ i) 49.325 kJ
Q2 a) 50 J b) 300 J c) 275 J d) 100 J e) 600 J f) 375 J g) 175 J h) 525 J i) 475 J
Q3 a) 3.9 kJ b) 2.775 kJ c) 5.025 kJ d) 1.8 kJ e) 3.45 kJ f) 5.175 kJ g) 1.575 kJ h) 4.125 kJ i) 5.475 kJ
Q4 a) 1.5 kJ b) 1600 kJ c) 100 kJ d) 2 J e) 10 kJ f) 180 kJ g) 4.9 kJ h) 40 kJ

Page 29 Work Done = Force × Distance

Q1 a) 1800 kJ b) 2380 kJ c) 1600 kJ
Q2 a) 6 kJ b) 5.4 kJ c) 7.8 kJ d) 27
Q3 a) 36 kJ b) 208 kJ c) 30.6 m d) 20.25 kJ each