**LESSON 1:**

**M1.**(a)     K

**1**

(b)     Decreases

**1**

(c)     use a metre rule / 30 cm ruler to measure across 10 (projected) waves

*accept any practical number of waves number for 10*

**1**

and then divide by 10

**1**

(d)     1.2 cm = 0.012 m

**1**

18.5 × 0.012 = 0.22(2) (m / s)

**1**

*allow 0.22(2) with no working shown for* ***2*** *marks*

typical walking speed = 1.5m / s

*accept any value e.g. in the range 0.7 to 2.0 m / s*

**1**

so the water waves are slower (than a typical walking speed)

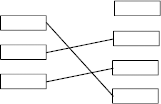
*this cannot score on its own*

**1**

**[8]**

**M2.**(a)     radio

**1**

(b)     

*award* ***1*** *mark for each correct line*

*if more than one line is drawn from any em wave then none of those lines gain credit*

**3**

(c)     ionising

**1**

**[5]**

**Independent exam questions**

**M3.**(a)      vibrate / oscillate

*accept a correct description*

*move is insufficient*

**1**

(b)     336

*allow* ***1*** *mark for correct substitution, ie 420 × 0.8(0) provided no subsequent step shown*

**2**

**[3]**

**M4.**         (a)      (i)     X-ray(s)

**1**

(ii)     gamma rays

**1**

(iii)    infrared

**1**

(b)     the same speed as

**1**

         (c)     (i)      horizontal arrow drawn pointing to the right

*judge by eye*

*accept drawn anywhere on diagram*

**1**

(ii)     **Y**

**1**

(iii)     any **one** from:

•        any type of electromagnetic wave

*accept electromagnetic wave(s)*

•        water (wave)

*do* ***not*** *accept seismic waves*

•        (earthquake / seismic) S waves

*do* ***not*** *accept P waves*

*do* ***not*** *accept earthquakes*

**1**

(d)     (i)      3

**1**

(ii)     3.6

**or**

their (d)(i) × 1.2 correctly calculated

*v = f × λallow* ***1*** *mark for correct substitution  
ie 3 or their (d)(i) × 1.2 provided that no subsequent step is shown*

**2**

**[10]**

**M5.**(a)     (i)       (visible) light

*accept visible*

**1**

(ii)     microwaves

**1**

(b)     J

**1**

(c)     (i)      B

**1**

(ii)     shorter than

**1**

(d)     (i)       To find out if using a mobile phone is harmful to health

**1**

(ii)     any **two** from:

•         (X has a) low(er) SAR value

*“it” refers to mobile phone*

*accept has a low(er) rate*

•         (maximum) energy absorbed (by the head) is less

*accept energy emitted (by phone) is less   
accept radiation for energy*

•         (if mobiles are harmful) less likely to cause harm

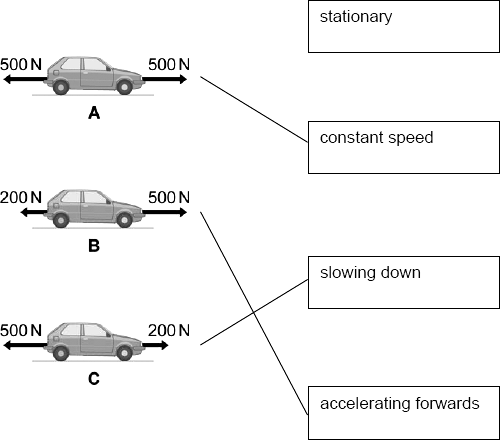
*accept will not cause harm   
accept it is safer*

**2**

**[8]**

**LESSON 2:**

**M6.**(a)     *3 lines drawn  
all correct  
allow* ***1*** *mark for each correct line  
if two or more lines are drawn from any diagram then all these lines are incorrect*

**

**3**

(b)     (i)      horizontal arrow to the right

*judge by eye*

*accept an arrow drawn outside the box if it is labelled correctly*

**1**

(ii)     horizontal arrow to the left

*judge by eye*

*accept an arrow drawn outside the box if it is labelled correctly*

**1**

(iii)    equal to

**1**

(iv)     to measure the forces exerted on the dummy during the impact

**1**

**[7]**

**M7.**(a)     time

*correct order only*

**1**

force

**1**

(b)     The car tyres being badly worn

**1**

(c)     (i)      braking distance increases with speed

*accept positive correlation*

*do* ***not*** *accept stopping distance for braking distance*

**1**

relevant further details, eg

•         but not in direct proportion

•         and increases more rapidly after 15 m/s

*accept any speed between 10 and 20*

*accept numerical example*

•         double the speed, braking distance increases × 4

**1**

(ii)      line drawn above existing line starting at the origin

*as speed increases braking distance must increase   
each speed must have a single braking distance*

**1**

(d)     (i)       reaction time / reaction (of driver) does not depend on speed (of car)

**1**

(ii)     (on the reduced speed limit roads) over the same period of time

*accept a specific time, eg 1 year*

**1**

monitor number of accidents before and after (speed limit reduced)

*allow* ***1*** *mark only for record number of vehicles / cars using the (20 mph) roads* ***or*** *collect data on accidents on the (20 mph) roads*

*to score both marks the answer must refer to the roads with the reduced speed limit*

**1**

**[9]**

**M8.**          (a)     distance travelled under the braking force

*accept braking (distance)*

**1**

(b)     (directly) proportional

*accept a correct description using figures*

**or**increase in the same ratio

*eg if speed doubles then*

*thinking distance doubles*

*accept for* ***1*** *mark positive correlation*

*accept for* ***1*** *mark as speed*

*increases so does thinking distance*

*accept as one increases the other increases*

*accept as thinking distance increases speed increases*

**2**

(c)     (i)      control variable

**1**

(ii)     experiment done, student listens to music / ipod (etc)

**1**

experiment (repeated), student not listening to music

*for both marks to be awarded there must be a comparison*

**1**

(d)     increase it

*accept an answer which implies reactions are slower*

*do* ***not*** *accept answers in terms of thinking distance only*

**1**

(e)     **Y**

**1**

**[8]**

**M9.**          (a)     centre of X at the point where the axes cross

*to within 1 mm in any direction*

**1**

(b)     (i)      (at / in the) centre (of the tyre)

***or*** *unambiguously shown on the diagram*

**1**

(ii)     (this is) where axes of symmetry (of the tyre) cross / intersect / meet

***or*** *point at which the mass of the tyre seems to be (concentrated)*

**1**

**[3]**

**M10.**(a)    4 N to the right

**1**

(b)     (i)      bigger than

**1**

equal to

**1**

(ii)     reduces it

**1**

increases air resistance / drag / force C

*accept parachute has large(r) (surface) area*

**1**

**[5]**

**LESSON 3:**

**M11.**         (a)      (i)     12

**1**

(ii)     0.2

*allow* ***1*** *mark for their (a)(i) ÷ 60 and correctly calculated*

**1**

m/s2

*accept correct unit circled in list*

*accept ms−2*

*do* ***not*** *accept mps2*

**1**

(b)     **B**

**1**

**[4]**

**M12.**          (a)     shallowest slope/ gradient

*accept smallest distance in biggest time  
accept longest time to travel the same distance  
accept the line is not as steep  
accept it is a less steep line  
do* ***not*** *accept the line is not steep*

**1**

(b)     **A – B**

*If 2 or 3 boxes are ticked no mark*

**1**

(c)     (i)      200 m

**1**

(ii)     20 s

*allow* ***1*** *mark for correctly identifying 60 s or 40 s from the graph*

**2**

(d)     (i)      straight line starting at origin

*accept within one small square of the origin*

**1**

         passing through t = 200 and d = 500

**1**

(ii)     166

*accept any value between 162 and 168  
accept where their line intersects  
given graph line correctly read ± 3 s*

**1**

**[8]**

**M13.**          (a)     MN

*accept 5.8, 8 seconds must include unit*

**1**

(b)     LM

*accept 0.8, 5.8 seconds must include unit*

**1**

(c)     (i)      0.8

**1**

(ii)     drinking alcohol

**1**

(d)     straight (by eye) line starting at 0.8 seconds

**1**

          line drawn steeper than LM starting before L

*ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating*

**1**

**[6]**

**M14.**          (a)     (i)      walking at constant speed

**1**

(ii)     standing still

**1**

(b)     is higher **or** faster

*accept less time to walk more distance (both time and distance must be mentioned)*

**1**

the slope of graph is steeper

*accept slope is more*

**1**

(c)     speed = 

*accept suitable symbols used in correct formula*

*do not accept a triangle*

**1**

**[5]**

**M15.**          (a)     60

**1**

(b)     5 hours

*must include unit*

**1**

(c)     30

**1**

(d)     30 minutes or

 hour

*must include unit*

**1**

(e)     D **and** E

*accept finish for E  
accept correct numbers from axes with units*

**1**

          least steep part of the graph

*accept covers smallest distance in a set time  
accept only moves 5 km in 1 ½ hours (accept anything between 5 and 6)*

*ignore horse is tired*

**1**

**[6]**

**LESSON 4:**

**M16.**(a)     terminal

**1**

(b)     5.4 (kg)

*correct substitution of 54 = m × 10 gains* ***1*** *mark*

**2**

(c)     (i)      0< a <10

**1**

some upward force

*accept some drag / air resistance*

**1**

reduced resultant force

**1**

(ii)     0

**1**

upward force = weight (gravity)

**1**

resultant force zero

**1**

**[9]**

**M17.**          (a)     (i)      friction

*accept any way of indicating the correct answer*

**1**

(ii)     gravity

*accept any way of indicating the correct answer*

**1**

(b)     (i)      accelerates **or** speed / velocity increases

*accept faster and faster (1 mark)*

*do* ***not*** *accept faster pace / falls faster  
or suggestions of a greater but constant speed*

**1**

         downwards / falls

*accept towards the Earth / ground*

*this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts*

**1**

(ii)     constant speed / velocity **or** terminal velocity / speed or zero acceleration

*stays in the same place negates credit*

**1**

**[5]**

**M18.**          •        gravity

•        accelerates

•        friction

•        falls at a steady speed

*each for 1 mark*

**[4]**

**M19.**(a)     starting / stopping the stopwatch

*human error is insufficient*

*reaction time is insufficient*

**or**

timing over the smaller distances

*accept not timing accurately*

*do not accept references to measuring distance incorrectly*

**1**

(b)     (i)      before

**1**

(ii)     increasing

*accept accelerating*

*it is not constant is insufficient*

*it is less than after four seconds is insufficient*

*it reaches a constant speed negates*

**1**

(iii)     calculate the gradient of the straight/steepest/constant section

*accept gradient of any section after 5.5 seconds/30 cm*

**1**

(iv)     drag (force) increases (as the ball bearing gets faster)

*accept frictional/upward force for drag*

**1**

(until) drag (force) = weight

**or**

(until) resultant force is zero

*accept upward force = downward force*

*accept till forces are balanced*

**1**

(c)     less than

**1**

ball bearing increases speed at a greater rate

*accept it travels the same distance in less time*

**or**

ball bearing has a greater acceleration

*accept the ball bearing is going faster*

**or**

terminal velocity has not been reached

**1**

so resultant force must be greater

**or**

as weight is the same (the drag must be less)

*accept warmer oil has a lower density/viscosity for 1 mark if neither of the two reason marks score*

**1**

**[9]**

**LESSON 5:**

**M20.**(a)     (i)      not moving

**1**

(ii)     straight line from origin to (200,500)

*ignore a horizontal line after (200,500)*

**1**

(b)     35 000

*allow* ***1*** *mark for correct substitution, ie 14 000 × 2.5 provided no subsequent step*

*an answer of 87 500 indicates acceleration (2.5) has been squared and so scores zero*

**2**

**[4]**

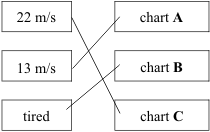
**M21.**          (a)     (i)      constant

**1**

(ii)     heat

**1**

(b)     (i)      3 links correct



*allow* ***1*** *mark for 1 correct link*

*if more than one line is drawn from a condition mark all lines from that condition incorrect*

**2**

(ii)     increased

**1**

**[5]**

**M22.**          (a)     (i)      0.6

*allow* ***1*** *mark for correct substitution*

**2**

         newtons

*accept N  
do* ***not*** *accept n  
accept Newtons*

**1**

(ii)     the same as

**1**

(b)     (i)      changed velocity

*accept increased/ decreased for change  
accept speed for velocity  
accept change direction  
accept getting faster/ slower  
accept start/ stop moving  
accept correct equation in terms of change in speed or change in velocity*

**1**

(ii)     down(wards)

*accept towards the ground*

*accept ↓*

*do* ***not*** *accept south*

**1**

**[6]**

**M23.**(a)    (produces) a force from water on the boat

**1**

in the forward direction

*accept in the opposite direction*

*this must refer to the direction of the force not simply the boat moves forwards*

*an answer produces an (equal and) opposite force gains* ***1*** *mark*

**1**

(b)     (i)       1.5

*allow* ***1*** *mark for correct substitution, ie  * ***or*** **

*provided no subsequent step shown*

*ignore sign*

**2**

m/s2

**1**

(ii)     102**or**their (b)(i) × 68 correctly calculated

*allow* ***1*** *mark for correct substitution, ie 1.5 × 68*

***or*** *their (b)(i) × 68*

*provided no subsequent step shown*

**2**

(iii)    greater than

*reason only scores if greater than chosen*

**1**

need to overcome resistance forces

*accept named resistance force*

*accept resistance forces act (on the water skier)*

*do* ***not*** *accept gravity*

**1**

**[9]**

**M24.**          (a)     A then E

*for one mark*

**1**

(b)     A > E  
A = E  
A < E

*in this order for 1 mark each*

**3**

(c)     when van stops / is stationary / is parked

*for one mark*

**1**

(d)     WX – slowing down (owtte)  
XY – constant speed (owtte)  
YZ – speeding up (owtte)

*for 1 mark each*

**3**

(e)     ….. force …. forwards …. backwards

*for 1 mark each*

**3**

**[11]**

**LESSON 6:**

**M25.**(a)     induced

**1**

(b)     bar 2

**1**

(the same end) of bar 1 attracts both ends of bar 2

**or**

only two magnets can repel so cannot be bar 1 or bar 3

**1**

(c)     so the results for each magnet can be compared

**or**

so there is only one independent variable

*fair test is insufficient*

*allow different thickness of paper would affect number of sheets each magnet could hold*

*accept it is a control variable*

**1**

(d)     because the magnet with the biggest area was not the strongest

*accept any correct reason that confirms the hypothesis is wrong eg smallest magnet holds more sheets than the largest*

**1**

**[5]**

**M26.**(a)     (i)      increase

**1**

(ii)     A and B  
and  
B and C

*both required for the mark*

*either order*

**1**

(iii)    any **two** from:

•        size of nail  
**or**nail material

*allow (same) nail*

•        current

*allow (same) cell*

*allow p.d.*

*same amount of electricity is insufficient*

•        (size of) paper clip

•        length of wire

*accept type / thickness of wire*

**2**

(b)     4

**1**

B picks up the same number as C, so this electromagnet would pick up the same number as A  
**or**direction of current does not affect the strength of the electromagnet

*allow it has got the same number of turns as A*

**1**

(c)     2

*allow 1 or 3*

**1**

**[7]**

**M27.**(a)     an electromagnet can be switched off

*accept a permanent magnet cannot be switched off*

**or**

an electromagnet is stronger

*accept control the strength*

**1**

(b)     Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a ‘best-fit’ approach to the marking.

**Level 3 (5 – 6 marks):**

there is a description of how the electromagnet is made

**and**

there is a description of how the strength of the electromagnet can be varied

**and**

there is a description of how the strength of the electromagnet can be tested

**Level 2 (3 – 4 marks):**

there is a description of how the electromagnet is made

**and either**

there is a description of how the strength of the electromagnet can be varied

**or**

there is a description of how the electromagnet can be tested

**Level 1 (1 – 2 marks):**

there is a basic description of how to make an electromagnet

**or**

there is a basic description of how the strength of the electromagnet can be varied

**or**

there is a basic description of how the electromagnet can be tested

**Level 0 (0 marks):**

No relevant / correct content

**examples of the points made in the response**

Details of how to make an electromagnet

•        wrap the wire around the nail

•        connect the wire to the power supply (with connecting leads and croc clips)

•        switch on the power supply

*accept a current should be sent along the wire*

Details of how to vary the strength of the electromagnet

•        change the number of turns (on the coil)

•        change the current (through the coil)

•        change the separation of the turns

*allow change the potential difference (across the coil)*

*accept wrap the coil more tightly*

Details of how to test the electromagnet

•        suspend paperclips from the electromagnet

•        the more paperclips suspended, the stronger the electromagnet is

•        clamp the electromagnet at different distances from the paperclip(s)

•        the further the distance from which paperclips can be attracted the stronger the electromagnet is

•        test before and after making alterations to change the strength

•        compare the results from before and after making alterations

•        use de-magnetised paper clips

*accept count the number of paperclips*

*with different current* ***or*** *p.d.* ***or*** *no. of turns*

***or*** *core and see if the number changes/increases*

**6**

**[7]**