M1. (a)   g.p.e. = mass × gravitational field strength × height

accept $E_p = mgh$

1

(b) $E_p = 50 \times 9.8 \times 20$

1

9800 (J)

allow 9800 (J) with no working shown for **2** marks
answer may also be correctly calculated using W = Fs
ie allow W = 490 × 20 for **1** mark
or answer of 9800 (J) using this method for **2** marks

1

(c)   7840 (J)

allow ecf from '11.2'

1

(d)   7840 = ½ × 50 × v²

1

$$v = \sqrt{\frac{7840}{1/2 \times 50}}$$

allow $v^2 = \dfrac{7840}{(1/2 \times 50)}$ for this point

1

17.7(0875) (m / s)

1

18 (m / s)

(e)   extension = 35 (m) and conversion of 24.5 kJ to 24500 J

1

24 500 = ½ × k × 35²

1

40

1

*allow 40 with no working shown for **3** marks*

*an answer of '16.2' gains **2** marks*

[11]

M2. (a)   *any evidence of:* momentum = mass × velocity (words, symbols or numbers)
appropriate re-arrangement mass as 0.05kg

each gains 1 mark

        but 800

                    gains 4 marks

                                                                                        4

    (b)   (i)   *any reference to* friction with air/air resistance
                    gains 1 mark

            but *idea that* friction with air/air resistance is high (at high speed)
                    gains 2 marks

                                                                                        2

        (ii)   *any evidence of:* k.e. $\propto v^2$ **or** k.e. $= \frac{1}{2}mv^2$
                <u>final k.e.</u>
                initial k.e.
                either initial or final k.e. correctly calculated (i.e. 16000; 10240)
                    each gains 1 mark

            but $(0.8)^2$
                    gains 3 marks

            but 64%(credit 0.64)
                    gains 4 marks (also credit e.c.f)

                                                                                        4
                                                                                                [10]

M3.   (a)   product of mass and velocity

                                                                                        1

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(b)　(i)　4kg or 4000g

1

　　(ii)　M = 8kgm/s or Ns
　　　　　for 3 marks

　　　　else M = 8
　　　　　for 2 marks

　　　　else M – mv or 4 × 2
　　　　　for 1 mark

3

　　(iii)　8 kgm/s (watch e.c.f.)

1

　　(iv)　v = 400
　　　　　for 3 marks

　　　　else v = 8/0.02
　　　　　for 2 marks

　　　　else M – mv, v – M/m or 8 = 0.02v
　　　　　for 1 mark

3

　　(v)　ke = 8
　　　　　for 3 marks

　　　　else ke = 1/2 (4 × 2^2)
　　　　　for 2 marks

　　　　else ke = 1/2 (mv^2)
　　　　　for 1 mark

3

　　(vi)　transferred to heat and sound
　　　　　or does work against wood/pushing wood aside/deforming bullet

1

[13

M4.　(a)　13 500 (J)

allow **1** mark for correct substitution, ie 90 x 10 x 15 provided no subsequent step shown

2

(b) 17**or**$\sqrt{\dfrac{their\ (a)}{45}}$

correctly calculated and answer given to 2 or 3 significant figures

accept 17.3

*allow **2** marks for an answer with 4 or more significant figures, ie 17.32*

or

*allow **2** marks for correct substitution, ie 13 500/ their (a) = ½ x 90 x v²*

or

*allow **1** mark for a statement or figures showing KE = GPE*

3

(c)   work is done

1

(against) friction (between the miner and slide)

*accept 'air resistance' **or** 'drag' for friction*

1

(due to the) slide not (being perfectly) smooth

accept miners clothing is rough

or

causing (kinetic) energy to be transferred as heat/internal energy of surroundings

accept lost/transformed for transferred

accept air for internal energy of surroundings

1

[8]