The Big 50 Revision Guidelines for M1

If you can understand all of these you'll do very well…

1. Understand what is meant by a Model in Mechanics, and why all real-life systems have to be modelled in order to be analysed theoretically
2. Know how everyday objects are modelled as Particle, Lamina, Rigid Body, Rod (Light, Uniform, Non-uniform), String (Light, Inextensible), Pulley (Light, Smooth), Surface (Rough, Smooth), Bead, Wire and Peg and the corresponding assumptions that go with each of these
3. Know the difference between a Vector and a Scalar quantity, and be able to give an example of each
4. Understand and use the idea of a vector to represent displacements, velocities, accelerations and forces in a plane
5. Know the difference between speed (a scalar) and velocity (a vector)
6. Know the difference between "mass" and "weight"
7. Know the difference between "gravitational acceleration" and "gravitational force"
8. Be able to explain what a force is without using the word "force"
9. Be able to explain what time is without using the word "time"
10. Given a velocity or acceleration in terms of unit **i** and **j** vectors, understand how to find its magnitude and direction, and vice versa
11. Know how to work with **i** and **j** components separately in calculations
12. Know how to write down straightaway the position vector at time *t* of a particle, given its initial position vector and the velocity with which it is moving
13. Understand the Triangle Law and Parallelogram Law for combining vectors
14. Understand how to apply the Sine and Cosine Rules for calculating angles between vectors

15. Know how to resolve any vector (force, velocity, acceleration) into two perpendicular directions using sine and cosine respectively

16. Be able to quote from memory at least five different formulae describing motion under constant acceleration, using the five variables in the mnemonic "*uvats*"

17. Know how to construct and interpret time graphs for Displacement, Velocity/Speed and Acceleration, with particular understanding of what can be determined from the gradient of, and/or the area under, the graph thus drawn

18. Be able to quote from memory Newton's three Laws of Motion

19. Know how to calculate momentum given the mass and velocity of a particle

20. Be able to explain the connection between Impulse, Force, Time and Momentum

21. Know the connection between the gradient of a slope and the tangent of the angle it makes with the horizontal

22. Know how to calculate any two of $\sin\theta$, $\cos\theta$ and $\tan\theta$ given the third, without finding the value of θ first

23. Know how to solve quadratic equations using a variety of methods besides "the formula"

24. Know how to solve simultaneous equations using a variety of methods

25. Be able to explain the connection between Friction Force F, Coefficient of Friction μ and Reaction Force R, in particular being able to explain the circumstances in which friction increases to a maximum value and then stays at that value

26. Be able to describe a scenario in which friction is acting up a slope, and then another scenario in which friction is acting down a slope

27. Understand how to read a given question in order to determine the nature and direction of friction in a question using clues like "about to move" or "on the point of slipping" or "at rest"

28. Understand how to draw a complete force diagram for a particle on a slope, in particular how to involve friction, gravity and reaction forces into the diagram

29. Understand how to draw a complete force diagram for two connected particles on a smooth pulley, in particular how to involve tension and gravity forces into the diagram

30. Understand how to draw a complete force diagram for a particle on a slope connected via a pulley to another particle hanging freely

31. Understand how to draw a complete force diagram for a loaded horizontal plank resting on two supports, in particular how to involve centre of mass, gravity and reaction forces, and turning moments

32. Understand how to draw a complete force diagram for a loaded horizontal plank suspended by two ropes, in particular how to involve centre of mass, gravity and tension forces, and turning moments

33. Understand how to model a car travelling at speed u in which the driver brakes with force F for a duration t in order to bring it to rest in a distance s, in particular knowing whether or not the mass of the car is important

34. Be able to describe completely, at all stages of its journey, the adventures and experiences of a particle projected vertically upwards from height h and speed u at time t=0

35. Be able to describe completely, at all stages of their respective experiences, the fate of two particles of masses M and m, heading towards each other with speeds U and u respectively

36. Be able to describe completely the misfortunes of a particle at rest on a slope which is made steeper and steeper until the particle can stand it no longer and slides downwards

37. Be able to describe completely the drama of a reluctant particle, initially at rest on a horizontal surface, which is finally persuaded to move by the action of a steadily increasing force

38. Know how to calculate the depth of a well by dropping a stone into it

39. Be able to explain in terms of forces why seatbelts are necessary in an aircraft during take-off and landing, but not during the flight

40. Be able to explain to a young child why it would be impossible in space to tell whether your spaceship was travelling at a steady 200 mph or was in fact stationary

41. Know how to calculate your weight increase in a lift accelerating upwards

42. Know how to calculate the initial velocity of a bullet which is fired vertically to reach a maximum height of 1000 metres, or to calculate the maximum height of a bullet fired vertically at 1000 m/s

43. Know how to model and calculate the situation of a football moving in a given direction towards a player who kicks the ball in a given direction with a given force for a given duration

44. Be able to demonstrate how a large adult and a small child can be made to balance on a simple see-saw

45. Be able to explain why bathroom scales would show an **increase** in weight if a person standing on them threw a large book upwards into the air

46. Be able to explain why a feather and a hammer released together by an astronaut would land on the moon at the same time

47. Be able to explain how a Newton's Cradle works

48. Be able to explain how a horse can tow a barge, or how The World's Strongest Man can pull an aeroplane weighing 44 tons

49. Be able to explain why a book suspended in the middle of a long rope makes it impossible for the rope to be held perfectly horizontally

50. Know how a wheelbarrow works, as well as other tools such as a sledgehammer, a screwdriver and a crowbar, and why a counterweight is needed on a crane